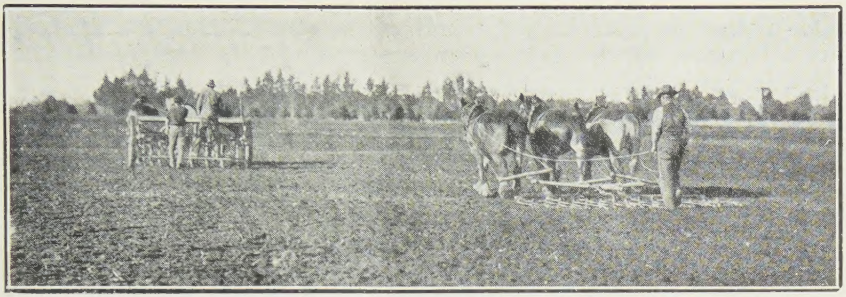

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GENITAL DISEASES OF CATTLE.*

TEMPORARY STERILITY AND CONTAGIOUS ABORTION.

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THE Department of Agriculture is particularly anxious to find practical means of helping dairy-farmers to combat genital troubles in cattle, and towards that end several of its Veterinarians—Mr. T. A. Blake, at Masterton, Mr. D. A. Gill, at Palmerston North, and Mr. A. McKenzie, at Hamilton, together with Mr. W. M. Webster, engaged in supervising meat-inspection at Wellington—are collaborating with the Wallaceville Laboratory in special investigation work. Researchers have been engaged for thirty years or so in other countries on similar work, and are no further advanced in arriving at the solution than we are. The difficulty of the work in hand may thus to some extent be realized.

TEMPORARY STERILITY AND GRANULAR VAGINITIS.

In order to grasp the theory for temporary sterility here put forward it is necessary to understand the physiology of the œstral cycle—that is, a period or a "bulling" of the cow. In a healthy œstrum the ovary produces an egg which is dropped into the fine tubule,

* Substance of an address to the Annual Dominion Conference of the New Zealand Farmers' Union, Wellington, July, 1925.

down which it proceeds to the horn of the womb. During this passage it is fertilized by the male sperm, and so is able to commence growth and become attached to the wall of the uterus. Should the cow not be served the egg passes out, in a mild menstruation often, and the cow does not show heat for another twenty-one or twenty-two days. When the egg is first passed from the ovary a blood-clot forms in the hollow left by the burst bladder in which the egg is formed, and this blood-clot later becomes a brown to yellow or orange body of the size of an acorn, half buried in the ovary and showing a projecting knob on the surface. While this "lutein" body, as it is called, remains in a normal state and does *not* degenerate the cow will *not* show heat, and when the cow conceives this body remains in place for thirty to sixty days after the birth of the calf. If the cow does not conceive, the lutein body degenerates sufficiently in eighteen days for a heat period to occur in from twenty-one to twenty-two days from the last period.

Some cows which do not return to the bull at all after calving, either normally or abnormally, are found to have this lutein body retained in the ovary—permanent sterility resulting; but if it can be expressed by hand the cow will take the bull in three days. Personally I have been able to express this body in three cows during the past season with satisfactory results, and my colleagues all have like experiences to relate.

Passing on to the condition of granular vaginitis, this can be described, in its simple state, as a granular eruption of the mucous surface of the vulva, just within the lips and extending rarely more than 3 in. to 4 in. forward. These granules become very red and inflamed, and are inclined to bleed during the act of copulation; also they become much more noticeable and sore at about the period of œstrum. Even though this inflammatory condition is so easily seen, the farmer is usually quite unaware of its presence unless there is at the same time a pronounced discharge, either from a further bacterial infection of a secondary nature or from disease of the mouth of the womb.

Granular vaginitis is so prevalent that one almost mistakes the appearance of the mild form of the disease for the normal condition of the vulva. It is known in all countries, but is not looked upon with very great concern. In New Zealand we have been associating it with the return of cows to the bull, a condition which has lately been very prevalent—a temporary sterility with which the cow finally takes the bull anywhere up to the end of summer—say, February. It is thought by some farmers that this is in some way connected with the hot weather. During last milking season a number of herds were examined and records taken to try and arrive at some conclusion as to the fundamental reason for this temporary sterility; and, while we (the investigators) are not prepared yet to say that granular vaginitis in its most severe stage is not a factor in causing temporary sterility, the mass of evidence certainly pointed to this disease not being the usual cause. While, on the one hand, cases are known where cows affected with vaginitis in its acute form have failed to hold to the bull, we have, on the other hand, met with experiences where the cow most severely affected was the first to hold to the bull, while cows which were considered so mildly affected as to be about normal refused to hold, and, what is more, returned at irregular

intervals. Looking more deeply into the question, one finds, with the aid of suitable instruments, that the mouth of the womb is often very much inflamed, and we believe that this is a much greater factor in temporary sterility than is vaginitis.

We believe—and laboratory and field work is in progress to prove or disprove the supposition—that infection passes from the mouth of

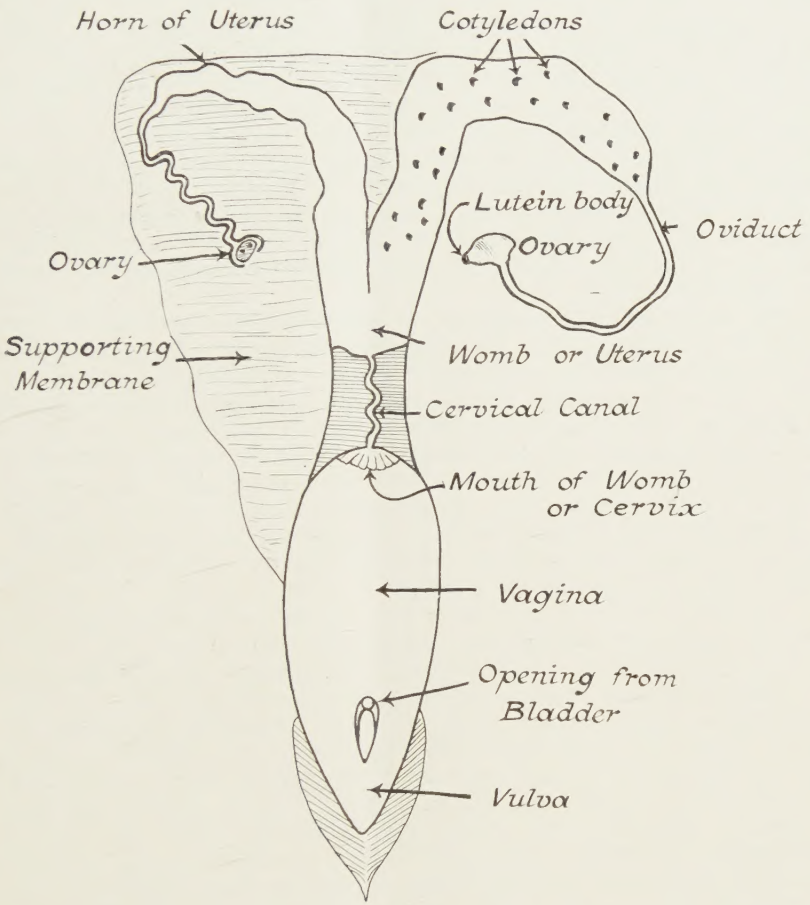

DIAGRAM OF GENITAL ORGANS OF COW.

the womb to the small oviducts and thence to the ovaries, the organisms responsible setting up a disease of the lutein bodies which causes them to become cystic. (Specimens shown.) While the property known as lutein is present in a certain quantity in the ovary, periods, which in the cow occur about every twenty-second day, are inhibited. If this material breaks down sufficiently in nine days, as is often the case when cysts are present, then one gets the cow returning to the bull in nine days; if two months is the time taken, then the cow remains

free from periods for that length of time and gives the impression that she is in calf. In all probability the egg from the ovary was killed by bacteria, either as it left the ovary or in the oviduct, and so could not be fertilized.

We are more than ever in favour of this theory of the breaking-down of the lutein bodies and premature death of the egg causing temporary sterility since specimens were collected in a recent cull-cow drive in the Wairarapa district. On this occasion Mr. Blake was able to trace histories of a number of the cows affected, and in the works to find that the ovaries of cows which repeatedly returned to the bull contained varying numbers of these cystic lutein bodies. Pregnant cows rarely show a cystic degeneration of the lutein body Of course, other factors may prevent the ovum from being fertilized. One is the possibility of a plug of mucous forming in the mouth of the womb during inflammation of that area, thus mechanically preventing conception. Another factor is the acidity set up by inflammation in an organ which is usually neutral or alkaline; acids are particularly harmful to the male sperm, and may prevent conception by causing death of the sperm.

Discharge from the mouth of the womb has been examined many times at the Wallaceville Laboratory, and shows in a large percentage of cases just two micro-organisms. These two, although present normally, somehow or other appear to have obtained greater power to damage the body-tissues than they previously possessed. It may be that with increased discharge from an inflamed cervix the wall of the vagina is made sodden, and that organisms flourish there at the expense of the vaginal wall. Possibly the original cervicitis—that is, inflammation of the mouth of the womb—is carried by the bull from one cow to another, and where this condition is rife the bull should be washed out after serving each cow.

It must be realized that cows kept under ordinary dairying-conditions cannot be expected to possess the same degree of natural resistant power to the invasion of disease germs which is possessed by cows living and breeding under natural conditions, such as exist, for instance, upon station properties where beef-producing herds are kept. There the cows breed and rear their calves naturally; they have a wide range of pasture, and their milk-producing capacity is not extended beyond the limits required for the rearing of their progency. On the other hand, the dairy cow fulfils her natural milk-producing function under less natural conditions; she has been developed into a milk-producer more or less in excess of what nature intended her to be, and she has to graze over a comparatively limited area of land which has been closely stocked with dairy cows, and perhaps contaminated by various diseases from which these cows have suffered for varying periods of years. Moreover, as a calf, in far too many instances she has been weakened in constitution by being reared artificially, often on inadequate food, instead of naturally upon good whole milk, as Nature intended her to be. All these conditions tend to lower the natural capacity of the dairy cow to resist the invasion of disease, and render it necessary for the dairy-farmer to observe in every way the principles of cleanliness, and to do all that is reasonably possible to maintain the bodily health and vitality of his cows by good feeding and good management generally.

It is, of course, recognized that economic conditions necessitate the farmer keeping as many cows as his farm is capable of carrying, and getting as much milk from them as he can; but it must never be forgotten that this entails the reducing of the disease-resistant powers of the cows. Moreover, the development of the milking-faculty of the cow beyond what Nature intended it to be is calculated to interfere with the normal operation of the generative organs, with which the udder is closely associated through the medium of the nervous system. Thus it is not difficult to understand why mammitis, failure of conception, abortion, or other troubles associated with the genital system are so common and so troublesome among dairy cattle and so rarely met with among station cows.

Following out this line of thought we are testing on several farms the usefulness of feeding phosphates to dairy cows. In the coming season we should like to try feeding of a more helpful nature with concentrated foods, in order to find just how far the system of a healthy cow can be built up to enable her to resist the infection. The great difficulty is to find suitable herds upon which to work. Again, it must be remembered that the dairy cow is not a normal animal, in that the milking-factor has been developed to such an extent that in heavy-milking breeds sterility is believed often to result; certainly fertility is interfered with. How far this has to do with our present trouble I am not prepared to say.

During the past year numbers of drugs have been tried for douching and drenching cows, but none has been used which has effected a cure for sterility. A mild disinfectant, however, is helpful towards overcoming the inflammation of the vagina, and possibly helpful in overcoming inflammation of the mouth of the womb; but the continuous use of an irritating fluid, often introduced in a dirty manner, greatly reduces the milk-production of the animal—merely from restlessness and fear, if from no other reason.

Although we do not place much credence on granular vaginitis being at the root of temporary sterility, we do believe that granular vaginitis is a communicable disease carried both by the bull and by other means. In Europe one bacteriologist has isolated a particular organism which he associates with this disease, but, as far as I am aware, nowhere else has this organism ever been isolated. Certainly I have not found it in repeated attempts at our own Laboratory, nor have I isolated any organism which will set up the disease in apparently healthy cattle. I use the term "apparently healthy" advisedly, as one often finds calves and heifers which have not been put to the bull affected with vaginitis. One American authority puts the blame for this on giving unboiled milk to calves, but such has not been borne out by our own experiments with a limited number of calves.

CONTAGIOUS ABORTION.

The second disease which I will deal with is contagious abortion. Unlike granular vaginitis, contagious abortion in New Zealand is directly caused by the ravages of a known bacillus. It is argued in some countries that this bacillus is not the chief one responsible for the slipping of calves, but, judging by cases of abortion investigated at Wallaceville, I have no hesitation in saying that in New Zealand it

certainly is the one. The disease of abortion has been known in cattle since ancient times, but the identification of the organism did not take place till 1896, when Professor Bang, of Copenhagen, demonstrated its presence in a number of experiments. Dr. Gilruth noted the disease in New Zealand in a contagious form in 1895, and since that date infection of cattle has gone steadily ahead. Possibly some general action by farmers at that time might have prevented the trouble we have now; but if New Zealand were clean in this respect (and wished to remain clean) it would be difficult for us to bring pedigree cattle from other parts of the world, as most countries are in no better condition than our own.

The chief symptom of the disease is the abortion of a dead fœtus of any period. Other symptoms, which may not be recognized as such, are retention of the afterbirth beyond the normal time, and the birth of dead calves. Sometimes, too, calves are born in a weakly condition and with an inclination to scour, but I do not believe that the white scour so common in America, and considered to be due to contagious abortion, occurs in New Zealand. I can, however, get no definite information on the point beyond the fact that it has not been noted by the Department of Agriculture.

The seat of infection in cattle is a matter for consideration. Primarily the womb is affected, and from there the membranes of the fœtus, an attack being made finally where the membranes attach to the walls of the uterus of the mother. The fœtus dies, and at death the womb, in the majority of instances, makes attempts to void the dead body, usually successfully. Round the membranes is a yellowish to brownish deposit, not in any way evil-smelling, and it is in this deposit that one finds crowds of the organism of the disease. Until the walls of the womb of the cow heal there will be a discharge through the vulva of the cow, dirtying the tail, and also falling upon and contaminating the paddocks. Once the womb has healed it will be found in the majority of cases that infection has passed into the udder, but whether this is through the blood-stream or up the teat-duct is a matter at present under discussion by scientific workers. It suffices for our purposes to say that the disease will lurk in the udder until the cow again becomes pregnant. This organism is harmless to the human race, though one very similar in all tests causes a disease called Malta fever.

Knowing where the organism is found, one may then consider how infection is spread. Chief of these means is the infection of paddocks both from dropping of uterine discharges and from excreta of calves feeding on milk from an infected herd. The cow picks up the contaminated fodder and so takes the germ into the system, where, if the animal is pregnant, it finds its way to the uterus. Should the cow not be pregnant it seems, by experiments conducted in several countries, that the organism may arrive at the udder and remain there until pregnancy, but this is not a point which need be given consideration here, except to mention that it is an argument against wholesale vaccination.

A method of infection which may take place is per medium of the bull. For a number of years this animal has rather been lost sight of as a disseminator of contagious abortion, but from the fact that an outbreak often occurs following the use of one particular bull (instances

of this happened last year in the Wellington District) one cannot afford to overlook this possibility. Two ways of infection are open—mechanically by serving cow after cow with a dirty penis, or by direct injection of the bacillus of abortion in the seminal fluid among the fertilizing elements which are placed in the vagina of the cow. It is not incredible that these organisms should find their way into the uterus with the sperm, being carried by it like a jockey on a racehorse once the barrier is down, the barrier in this case being the mouth of the womb, which at the time of period is relaxed. One finds bulls reacting to tests occasionally, and in these cases the organisms may often be isolated from one or other of his genital organs.

Another factor in the spread of the disease is the carriage of the organism from one cow to another by flies, and as this is possible experimentally there seems no reason why it is not possible under field conditions. Eradication of flies, of course, should come under the sanitary arrangements of a dairy farm, whether abortion-infected or not.

In the body of the cow, on account of the war waged between the bacillus and the body-cells of the animal, there is formed a certain material known as agglutinin—an agent which causes the germs of the disease to clump together—and this forms the basis for the blood test which is used in the diagnosis of the presence or absence of the disease contagious abortion. If agglutinins are present it is known that the organism has been recently, or is, present in the body of the animal, whether in the uterus or in the udder. Thus any farmer, by taking a small bottle of blood from the ear or tail of his cow, may obtain knowledge as to whether his cow is affected or not. The agglutination test does not tell whether the cow is going to abort or how badly she is affected, but only that she is affected — which, however, is of some use. It would surprise most farmers to know what proportions of their cows are carriers of the disease, and therefore possible aborters at some time. Certain cows appear to become immune to some extent, and only abort once; but others will abort more than once, or will abort once and have several healthy calves and finally abort again. From that one cannot say confidently what will happen in a given herd.

To give an idea of the economic loss which may occur in New Zealand—not considering the actual loss of milk and calves from cows which abort before milk has been secreted—I may quote some figures which speak for themselves. They were culled from an American paper, but were obtained from a pedigreed herd and vouched for by scientific investigators. The herd was separated by test and retest into affected and non-affected animals. In the affected herd eight became permanently sterile, and in the non-affected herd none showed sterility.

	Reacting Herd. (8 Cows sterile.)	Clean Herd. (None sterile.)
Average number of cows ..	24	18
Total milk-production ..	64,447 quarts.	94,458 quarts
Total cost of production ..	£1,863 5s.	£1,720
Cost per quart	7½d.	4½d.

The question may well be asked, Does it pay to keep a badly affected herd when it is possible to clean one's herd?

Besides actual abortion one must consider the after-effects. In a proportion of cases sterility results, either temporary or more usually permanent. This often comes about from an infection by other dirt organisms, following the action of the abortion bacillus, which has reduced the tone of the genital apparatus and its resistance to disease. These parasitic organisms gain entrance to the womb itself, to the oviducts, and to the ovaries, causing abscess formation or other troubles, but rendering many animals sterile by one means or another. If abortion is reduced in a herd the number of non-breeders is automatically decreased.

As already indicated, I am not able to state a definite cure once the disease is established, but can go into the manner of dealing with a dairy herd which is affected. I shall divide the matter of prevention into two parts—one for herds only slightly infected, the other for herds badly infected. In either case the blood-samples must be tested at the Wallaceville Laboratory, and for test purposes it is as well to send about one dessertspoonful of blood in a small corked bottle marked with the name of the cow, the blood being taken into clean boiled bottles in as cleanly a manner as possible. A covering description of the herd is of very great use if forwarded at the same time as the blood-samples.

In a herd of fifty or so with, say, only 5 per cent. affected much the wiser plan is to get rid of any cows or bulls reacting to the blood test. Neighbours do not want these animals unless their herds are badly infected, and the safest place for such stock is the slaughter-house. A retest of the herd should be made from six to eight weeks later, and any reactors again eliminated. After that a test of the herd annually or biannually will give the information required to keep the herd clean. When buying in stock care should be taken to obtain animals tested before calving, or empty heifers which have not been placed to the bull previously. Such stock should be retested by the buyer at the first opportunity, even, if possible, before running them with the herd. It is said that a herd clean from the abortion point of view is also one in which contagious mammitis is only rarely seen. Personally I think this is more because the owner of such a herd is a careful farmer who rids himself of infectious stock.

In a herd badly infected the farmer must decide whether he will continue under existing conditions, suffering more or less loss in the herd annually and having all introduced stock infected, or whether he will endeavour to build up a clean herd round his affected one. This latter will depend upon the acreage and the keeping of heifer calves, and acts on the same principle followed in the eradication of tuberculosis. As non-pregnant heifers are clean, if put to a healthy bull and kept away from infected cattle and infected paddocks there is no reason why they should not remain healthy. They must be kept in separate paddocks; but it appears that if milked first in a clean shed and kept otherwise in separate holding-yards there should be no great difficulty in keeping such a herd free. Frequent tests would decide the point.

The whole position is different where the herd is a badly infected one and is to remain so, the heifers being introduced to the herd and contracting the disease at once, and obtaining what immunity they

can against it as they grow older. The chief factor under such conditions is to keep each cow which does abort well cleaned out, and to keep her isolated from the cows in calf or in milk during the time she is discharging. The discharge falling on the grass contaminates the paddocks, and so isolation is essential. All aborted material must be carefully collected and either burned or dug deeply in before dogs pull the fœtus all over the paddock and spread infection everywhere. Any mild disinfectant does for washing such cows; corrosive sublimate or other drastic drugs should not be used, as they tend to damage the surface of the genital tract. Calves must be kept in separate paddocks from cows, for they soil the grass as effectively as do discharging cows. Bulls also require attention. Where the bull is run with the herd very little can be done to prevent spread of infection through him, but where each cow is taken separately to him (and this appears to be the wiser procedure, inasmuch as one is sure of the dates) he can be washed out between services, so making sure that he cannot infect cows mechanically. Should he be infected in the genital organs, then the agglutination test will have caught him. Washing out a bull is not difficult so long as the race or bail is strong enough to hold him, and he soon becomes reconciled to the treatment.

One other form of treatment is that of vaccination. As a live vaccine is the only one that has proved at all beneficial, it will be understood that one must be very careful how it is introduced into a herd, more especially if the herd is moderately clean, as most of the cows vaccinated become carriers. Some success for vaccination is claimed in Great Britain, and we are attempting to vaccinate a few herds in New Zealand this coming season, where the owner does not object to take the risk. This, however, is as yet only from an experimental point of view, and not as a matter of routine.

WHEAT AND OAT TRIALS AT WINTON EXPERIMENTAL AREA, SEASON 1924-25.

LAST season's wheat varieties at the Winton Experimental Area followed forage crops, and the land used for oats was ploughed out of lea. The wheat was sown on 29th August, and the oats on 15th and 16th September, 1924. The fertilizer used in both cases was basic super at 2 cwt. per acre. The yields per acre were as follows:—

Wheat: Solid-straw Tuscan, 41·4 bushels; Major, 37 bushels; Velvet, 32·3 bushels; White-straw Tuscan, 31 bushels; Marquis, 26 bushels. The Marquis variety was the first to ripen, and small birds did considerable damage, the yield being thus reduced by several bushels per acre.

Oats: Black Supreme, 89 bushels; Providence, 86 bushels; New Abundance, 70·25 bushels; Crown, 68·75 bushels; Captain, 68 bushels.

A 5-acre block of Black Tartarian oats grown for chaff returned 3·4 tons per acre.

Noxious Weeds Orders.—The Waimarino County Council has declared Californian thistle *not* to be a noxious weed within its territory.

HILL-COUNTRY GRASSLAND IN THE NORTH ISLAND.

A. H. COCKAYNE, Director of the Fields Division.

[This matter was published with the report of the Committee of Investigation into the deterioration of Crown lands in mid-western districts of the North Island, the main part of which appeared in last month's *Journal*.]

HILL-COUNTRY grassland can be divided into two great groups—that where the objective of management is to maintain and increase the percentage of the best grazing-grasses, such as rye-grass, cocksfoot, Poa pratensis, crested dogstail, and clovers; and that where the objective is to secure and maintain as complete a grass sward as possible, irrespective of what grasses it may be composed of. In the first case the objective is to keep out as much as possible grasses, such as danthonia and brown-top, which when dominant are not conducive to high carrying-capacity of wet stock. In the other case the objective is to avoid dominance being secured by objectionable vegetation, such as one or other of the ferns, or scrub growth.

Old-established hill pastures where the best English grasses are in the ascendancy are comparatively rare except on certain very fertile soils. The larger proportion of our well-grassed hill pastures are danthonia-dominant, particularly in the drier regions; and brown-top as the dominant element is conspicuous over wide areas where the rainfall tends to be fairly heavy and the ground is not exposed to extreme drying-up in the summer. The present general system of management is tending towards increasing the dominance of danthonia and brown-top over much country that should be supporting a larger proportion of the better English grasses. Better cattle-manipulation, rational subdivision to enable areas to be summer-spelled, and the use of phosphatic top-dressing are the three main factors that are involved in the management of country where danthonia and brown-top are tending to reduce the percentage of wet stock that can be carried. In the drier parts of the North Island where fern and scrub are gaining the upper hand methods tending to an increase in danthonia are the keynotes of management; burning, sowing with danthonia, self-sowing of danthonia by sheep from danthonia country, and frequent burning of the danthonia itself are all useful. Later on, when the country becomes danthonia-dominant, efforts should be made to convert the pasture into mixed English grasses and danthonia by all those methods that tend to soil-fertility increase.

The problems of the management of our danthonia and brown-top dominant grasslands are as important as those involved in the management of the truly deteriorated hill pastures, and call aloud for extensive and well-directed research work. It has to be remembered that the danthonia and brown-top dominant grasslands have mainly developed from the surface sowing of the lands with grasses that now only represent a fraction of the herbage, the sown grasses giving out more or less rapidly and their place being taken by others more fitted for the lower soil-fertility that has been brought about largely through

the exhaustion of the surface fertility present after the initial burn. Over wide areas of the North Island, however, the initial sowing with the so-called best English grasses had not been followed, on their thinning-out, by an invasion of such grasses as danthonia and brown-top. It is country of this description that is represented in such a county as Whangamomona, where a few years' luxuriant growth of the sown grasses has been followed by invasion, in varying degrees of intensity, of objectionable second growth, most of which probably represents initial stages of reversion, with forest as a final phase. Somewhat similar experiences have not been unknown over many areas that are now well grassed in counties such as Pohangina and others. In all these, very extensive and at the time apparently destructive secondary fires have swept the country from time to time, but they have been of great value, grass-recovery having been quicker than secondary-growth recovery. It is rather significant that in a district such as Whangamomona no really general severe burning of the whole country has been experienced; and (although this is pure surmise on my part) until such has taken place I am afraid secondary growth will tend to increase rather than diminish.

The problem of secondary-growth suppression is, however, extremely complex, and varies enormously with regard to the dominant type of vegetation that has to be dealt with. In one place it may be hard fern, in another bracken, in another water-fern, in another manuka, in another wineberry or fuchsia. Our knowledge of the exact conditions that determine dominance and succession in secondary growth is extremely meagre, and exact research work in this connection is a fundamental prerequisite in the formulation of control methods. It is hardly expected that the Committee can be in a position to state definitely what methods are necessary to suppress second growth on those areas where the initial sowing with English grasses under ordinary accepted methods of management is not followed by permanent replacement by such grasses as danthonia and brown-top. The fact that such large areas of country are rapidly becoming ruined for successful pastoral occupation indicates that the present methods are unsatisfactory. As the evidence gathered together must have been secured in the main from farmers who have not been able to cope successfully and economically with secondary growth, it is clear that any recommendations they may have made can only be in the nature of surmise rather than the result of successful experience. Even in those cases where pasture-permanence has been more or less maintained—a condition that occurs scattered through the whole area under discussion—the exact reasons why partial success has been secured are obscure.

The problem appears to present two distinct phases—firstly, what should be done in order to enable present holders to hang on, as it were, to their holdings; and, secondly, the actual try-out under controlled conditions of all methods of secondary-growth suppression, in order to work out an accurate system of management that may lead to permanent and successful occupation of the land. It must not be forgotten that, as regards holdings that have almost wholly reverted to secondary growth—and this is particularly true of hard fern—there are no examples on a large scale where elimination of the secondary growth has been secured by the adoption of any definite set plan of operations.

Many surmises with regard to methods of control are in the air. These can be divided into the following groups :—

METHODS OF CONTROL.

(1.) *Increasing the number of cattle grazed.*

At the present time Whangamomona County has about one cattle-beast to every 12 acres of originally sown country, excluding the dairy cows that are occupying the majority of the better-grassed areas. In such a county as Weber, where grassland is good but mainly of the reverted danthonia and brown-top type, one cattle-beast to about 8 acres of sown grassland is kept. It would appear as if the number of cattle necessary to effect any control on second-growth country would have to be largely increased, when it is seen that even when the country is in excellent grass one cattle-beast to every 8 acres to 10 acres is necessary. In Weber County, although there is a cattle-beast to every 8 acres, the relation of cattle to sheep is one to fifteen. The proportion of cattle to sheep in Whangamomona County is about one to eight. Grassland farmers in the North Island have been in the habit of using the figure between cattle and sheep as the index, whereas it is the relation between cattle and number of acres that is the real index that determines whether sufficient cattle are being employed. On good grassed country one cattle-beast to every 8 acres to 10 acres, and even less, tends to increase the number of sheep that can be kept. For instance, in Patangata County—the highest sheep-carrying-capacity county in New Zealand—one cattle-beast to 6 acres of grassland is kept, approximately half the sheep being wet ewes,

The following table gives the numbers of stock carried per 1,000 acres of sown grassland for certain counties in the North Island :—

County.	Dairy Cows.	Other Cattle.	Sheep.
Waitomo	57	160	650
Whangamomona	28	90	700
Kawhia	44	220	730
Ohura	50	160	800
Kaitieke	30	120	1,100
Makara	70	70	1,400
Castlepoint	2	160	1,700
Akitio	6	150	1,700
Uawa	15	140	1,800
Weber	4	130	1,800
Patangata	12	170	2,000

One point that appears fairly clear is that an increase in the amount of dairying carried out leads to a very rapid deterioration of the hill country: in other words, the dairy cow is a useless factor in the control of secondary growth. The ewe, again, in contradistinction to the wether, is a factor that exerts an influence in the direction of increase in secondary growth, and much country at present partly used for wet sheep is quite unsuitable for the purpose, having permanency of the grass sward other than by artificial manuring in consideration. However, both the dairy cow and the ewe are potent sources of immediate

revenue, and their elimination on holdings where secondary growth is rapidly gaining the upper hand would render the immediate returns from such holdings quite insufficient for the owners to remain in occupation unless their finance was in good shape—a comparatively rare circumstance even at the present time, when meat, wool, and butter-fat are all on a high level.

On land where the sheep-carrying capacity is low, owing to the large proportion of ground being occupied by secondary growth, increasing the number of cattle must (unlike on good danthonia country) tend to reduce the number of sheep kept, and, as the yearly grazing-value of a store cattle-beast is low, this would cause a reduction in the gross annual returns. A surprising feature in the deteriorated grass-lands of Whangamomona County is the really high carrying-capacity of the land actually carrying a grass sward. In that county 108,000 acres of forest have been grassed, and I should say at a guess more than 40 per cent. is occupied now by secondary growth. There are probably less than 50,000 acres of actual good grass, of which 3,000 dairy cows will be occupying at least 9,000 acres, which means that the actual grassland itself is carrying virtually two sheep to the acre. Were it not for this fact one would have the very gravest doubts as to whether it were worth while either to try and assist the present holders or to suggest any extensive research and experimental work into the question of secondary-growth suppression on such country.

I think it is fair to assume that an increase in cattle would tend to reduce second-growth invasion, and if such is the case the practical aspects require careful consideration. On country that is moderately clean the extension in the use of cattle would not result in any great yearly loss; but it is essential that a thorough study of the economics of cattle as a means of control should be immediately made, so far as possible, with reference to all the varied types of country. This study should secure the basis for a series of experiments on the effects of cattle-stocking at varying degrees of intensity, and the acreage cost of keeping the cattle under different systems of management, such as where breeding can be done, where cattle can be kept throughout the year, and where cattle have to be periodically bought and sold. The relation of fencing to the density of cattle-stocking, and the variation in the acreage cost of necessary fencing according to the size of the holding and the acreage density of cattle kept, are important. With fairly reliable information under these heads it might be possible to outline methods for the Government financing of cattle-purchase, with a reasonable expectation that the costs would be finally recoverable. Personally I might add that I do not consider that a mere increase in the cattle kept will be found economically sound except where the holdings are comparatively large. Fencing-costs, reduction in sheep carried, the increased cattle-density necessary compared with that of large holdings, and the necessity of often having to buy on a high market and sell in a low one, preclude cattle being the sheet-anchor of control on small holdings.

(2.) *Introduction of grasses and clovers more likely to be permanent and resist second-growth invasion than the standard English grasses.*

Roughly expressed, it may be said that the hope of every holder of second-growth invaded country is that the country will turn into

danthonia grassland, as has been the experience on much of the surface-sown hill lands of the North Island. Danthonia, however, belongs to the class of grasses known as light-demanders, and cannot possibly obtain the upper hand when shaded. Danthonia will not endure even a moderate amount of shade, and is likewise not particularly tolerant of an extremely wet climate. A wet climate is, on the other hand, of great benefit to the development of secondary growth. Again, provided it is not shaded, danthonia prefers well-consolidated rather than loose land. Generally speaking, all the conditions for rapid danthonia-spread are absent from the country that has so badly reverted to second growth, and unless methods favouring its development can be adopted in the region in question there is no reason to believe that danthonia will become generally dominant unless the amount of burning done can be vastly increased. On sunny faces, provided fern and scrub growth is kept out, danthonia is always likely to become established and spread, irrespective of whether it is intentionally sown or not. It is generally admitted that intentional sowing will lead to more rapid establishment than where no sowing is done, but actual sowing of danthonia, particularly in combination with other grasses, is often extremely disappointing. Burning, by removing shade, frequently has a marked effect on danthonia-spread, and in fact, in the past, has been one of the main factors that has led to its dominance over wide areas.

The establishment of a close and continuous sward of some grass or combination of grasses is essential in the suppression of secondary growth, and the fact is being strikingly demonstrated that the only type of grasses that are likely to be suitable in this respect are those that are capable of spreading on soils of low surface fertility. The main grasses that come to one's mind are danthonia (work on the fertility and shade factors with regard to the different forms of the pilosa, racemosa, and semiannularis groups may yield very significant results); brown-top and its forms; ratstail; tall oat-grass (perhaps on account of its suitability for loose soils); paspalum; and perhaps tall fescue. It would appear as if it were essential to try and make one or other of these grasses the dominant one on second-growth country, so that wherever any thinning-out took place the likelihood would be that the vacant spaces would be seized on by grass rather than by undesirable vegetation. Other grasses, such as crested dogstail, Poa pratensis, and *Microlaena*, are all likely to prove useful. Rye-grass most certainly should never be sown on burnt-out patches of secondary growth, except perhaps where the soil-fertility is still high and the value of cocksfoot is more than doubtful.

Generally speaking, the reasoning that has been adopted in the past on initial sowings is that the mixture should contain a combination of the better grasses which keep going for a few years and a certain amount of such grasses as danthonia and brown-top to occupy the ground rendered vacant by the thinning-out of such grasses as rye and cocksfoot. Whether this reasoning is really sound or not I rather have my doubts. Unfortunately, in much of the present deteriorated country only rye-grass/cocksfoot mixtures with a small proportion of crested dogstail and clovers have been sown, and the sowing of combined high-fertility elements and low-fertility elements together on the

initial burn has not been under any exact observation. Were I advising on the sowing-down of initial burns of Whangamomona district country at the present time I should be inclined to exclude all rye-grasses and cocksfoot, and make brown-top, danthonia, crested dogstail, paspalum, and Poa pratensis the only grasses to use, together with white clover (the question of wild white clover is one that must be investigated on hill pastures), suckling-clover, Lotus major, and perhaps subterranean clover. I would likewise be inclined to sow a certain amount of fog, particularly if the burn was not a really good one.

Quite apart from the mixtures to be used on land where the original sowing has been replaced by secondary growth comes the question of the formation of the seed-bed and whether the seed should be mixed with manure. One can divide the types of vegetation on which reseeding should be done into hard fern, bracken fern, water-fern, manuka, and particularly pasture that is thinning out but may not be seriously invaded by second growth. On this last type of vegetation a seed-bed cannot be secured by burning, and in attempting the renovation of such a sward I would advise the sowing of brown-top and crested dogstail with about 1½ cwt. of super per acre on the dark faces, and brown-top, danthonia, crested dogstail, and paspalum together with manure on the sunny faces. Lotus major and perhaps subterranean should be the main clovers used. In the sowing of second growth of all kinds a seed-bed formed by burning the growth, either standing or with some prior treatment depending on its type, naturally would take place, and I would again make what are generally looked upon as the poorer grasses and clovers the only ones to be used.

One of the outstanding difficulties of the introduction of grasses and clovers to second-growth country is the fact that all the species of any value are exceedingly high in price, and if any heavy seeding is carried out the cost is excessive. The present experimental areas in the Whangamomona district are of very great value in this direction, and present indications are that brown-top can be established easily, rapidly, and with quite a light seeding. Following are the approximate prices per pound of grasses and clovers likely to prove valuable: Brown-top, 3s.; Danthonia pilosa, 2s.; Danthonia semiannularis, 2s.; crested dogstail, 1s.; paspalum, 1s. 6d.; Poa pratensis, 1s. 6d.; rats-tail, 2s. 6d.; Lotus major, 3s. 6d.; subterranean clover, 6s. The question of a cheapening of these seeds is one of great importance, and the matter of financial assistance by the Government enabling a combination of farmers to grow their own requirements should be considered. I do not mean the growing of the seed in the districts themselves, but the actual establishment of a seed-growing farm—say, for brown-top—in whatever district is most suitable; financial assistance to secure supplies of danthonia-seed, and the like. A careful study of the present experiments in operation should prove most valuable in working out what mixtures are best, and a considerable extension of the work in progress should be undertaken.

(3.) *Phosphatic top-dressing of second-growth grassland.*

The wonderful results that have followed the top-dressing of worn-out grassland in many parts of New Zealand have led to the general

idea that in top-dressing lies the salvation of the second-growth grasslands of the North. There is no doubt that top-dressing, rationally carried out, will prove of great value, but just how, when, and where top-dressing should be done is hard to answer satisfactorily. Top-dressing of weak grassland and of any portions that are moderately well grassed appears to me to be sound under nearly all circumstances. Top-dressing will increase the feed produced and thereby increase the stock carried, and increase in stock-carrying capacity is perhaps the most potent factor of all in the control of second growth. There are, however, certain points that have to be considered. Firstly, the amount of fertilizer material necessary may have to be fairly large, and repetition of application necessary before any decided advantage is secured—which means that top-dressing will be expensive; secondly, the most striking immediate results will be secured from the better-grassed areas. As these areas will mainly be on the flats and lower slopes, top-dressing them will tend to keep stock only on the top-dressed areas, and, unless fenced off, the tendency will be for stock not to penetrate at all the higher slopes, and second growth may in this way be increased rather than diminished. This is perhaps a more important point than is generally considered.

The cost of hand distribution of artificial manure need not be considered, as the ordinary labour of the farm can in all cases do all that is necessary. In point of fact, methods whereby the actual manual work of the owner can be devoted to the control of second-growth suppression have not as yet been given the attention they deserve. It will be noted that the three great generally suggested methods of control—increasing cattle, the sowing of low-fertility-demanding grasses, and top-dressing—are all expensive and require considerable capital, whereas the one method of management that does not in many cases require any additional capital—actual mechanical control by hand labour—has as yet not been vigorously applied. It is remarkable that on many holdings considerable manual work is willingly undertaken against vegetation that is of no moment whatever, particularly against foxglove, whereas against the really serious invaders the farmer is content to put forward suggestions of getting some other agency to do the work for him—namely, cattle, grass-seed, and artificial manure.

I have mentioned with regard to cattle the necessity for extended scientific investigation, and the same holds true with regard to resowing, top-dressing, and manual treatment. The work should not be carried out on any one special experimental farm, but adequate funds should be available to put under trial conditions on many farms all possible methods of management. In addition to the actual money required for cattle, fencing, seed, and manures, expert scientific supervision is necessary, and extra assistance should be provided for Mr. E. B. Levy (Agrostologist). I would also suggest that a very complete study of the economics of hill-country grassland farming should be carried on simultaneously with any experimental work undertaken, and that for this purpose a small branch of the Fields Division be formed devoted to the study of agricultural economic problems, among which, to begin with, the question of the economics of second-growth country should be carefully studied.

(4.) *What should be done to relieve the present unsatisfactory condition of many holdings.*

In the foregoing I have indicated the four great methods of secondary-growth suppression that have been suggested—cattle, resowing with low-fertility-demanding grasses, top-dressing, and direct manual labour. With regard to the efficacy of these methods, under what conditions they should be put into operation, their costs and probable returns, very little of any definite value is known, and accordingly the foundation of a policy of assistance is sadly handicapped. Why have the holdings gone back? is the question that requires answering, and probably in ninety-nine cases out of a hundred the holder will say, "Through lack of sufficient capital to adequately work the holding." Just what capital is required to keep such grassland in good order? Does it vary per acre according to whether the holding is a small or large one? Would in many cases the money required be greater than any ultimate value of the land? Personally I consider that the country has gone back for several reasons. Firstly, the original sowings, being mainly rye-grass and cocksfoot, were quite unsuitable for any but the flat land and more fertile portions of the lower slopes; secondly, it was not recognized that the cost of maintaining such country in grass was much higher than currently supposed. The non-recognition of this fact led to excessive values being credited to the land, and in consequence an excessive percentage of the returns had to be swallowed up in rent, rates, and interest on fictitiously high values.

I would suggest that a survey of the deteriorated holdings be made, and that they be divided into the following classes: (*a*) Holdings that in their present condition cannot produce sufficient money annually to defray their annual financial obligations; (*b*) holdings that in their present condition can return sufficient to defray financial obligations, but cannot support in a reasonable manner the holder and his family; (*c*) holdings that in their present condition can defray annual expenses and support the holders, but with insufficient left over to put back into the properties to maintain or improve them; (*d*) holdings that in their present condition can support all their financial obligations and enough to maintain and improve them.

The first type of holding should be abandoned, or in certain cases be combined with other holdings. The second type should have the interest charges lowered. The third type should have liberal assistance given, provided the holders are deficient in capital. Nothing should be done with the fourth type of holding. No doubt a considerable number of holdings will have to be abandoned, and be taken over later by other owners who have good properties, who by their aid may be able to break in the country. I should like to add here that excessively small holdings have been in the past a potent factor in failure to maintain a grass sward on much hill country.

I would suggest that the following main principles should be adopted in the giving of assistance: (1.) No Government rent to be charged for land in forest or which has completely reverted to second growth. (2.) Expenditure on fencing, seeds, and manures used for reasonable improvement purposes to be accepted in lieu of rent.

(3.) Methods adopted whereby mortgages are reduced when it is clear that they, in combination with other charges, exceed the present value of the land, and where the land cannot in its present state provide for annual payment and allow a holder sufficient money to live in a reasonable manner. (4.) Expenditure on fencing, seeds, and manure to be accepted in lieu of a certain portion of the interest charges, arrangements being made whereby such interest waived may afterwards be recovered if the land is sold at a profit. (5.) Advance of Government money for the purchase of cattle. (6.) Free railage of manure. (7.) All cases where assistance is to be rendered to be investigated by a competent Board representing the interests of the Government, the State Advances, the Public Trust, and private mortgagors and owners, before any help is given.

In all cases the probability of the land finally fully recovering all costs that may be incurred should be carefully considered, and, where expenditure is held to be justified, all those interests that have an equity in the holding should share in the expenditure before the Consolidated Fund is called upon. Rent-remissions and mortgage-reductions in themselves will not improve the country. Their equivalent must go back into the land if stability of occupation is to be secured.

PASTURE TOP-DRESSING TRIALS AT TE KUMI.

FURTHER PROGRESS RESULTS.

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The experiments dealt with in this and two earlier progress reports (*Journal*, May, 1922, and April, 1923) are part of a series of top-dressing trials on pastures in the Auckland Province. The object set out was to determine the relative economic values of the commoner phosphatic fertilizers used by farmers for top-dressing. The trials were commenced four years ago. Ground raw rock phosphate, basic slag, and superphosphate have, during that period, been tested side by side with control areas which have not received any fertilizer. Plots were set out at Pukekohe, on medium volcanic loam of good quality; at Te Kumi, near Te Kuiti, on undulating ploughable fern-land, the soil being a light loam with a subsoil stiffer in nature; and at Helensville, on the Parakai Flats, on heavy alluvial soil of first-class quality. The method used for comparing the value of one fertilizer with another has been twofold: (1) To carefully weigh the hay cut from the plots and compare the weights thus obtained; and (2) to regularly examine the pastures on the plots at different seasons throughout the year, and record any changes noted in the pasture. Particular attention has been given to any improvement from the grazing standpoint.

Though results have been published from the Te Kumi trials, no reports have officially appeared of the results at Pukekohe nor Helensville. The reason for withholding the results so far secured at

these places has been that while there was a distinct improvement from phosphatic manuring at Pukekohe, but a much less response with all fertilizers at Helensville, the comparative differences in yield brought about by the different fertilizers were not considered great enough to place as yet sufficient reliance on them as real. Subjecting the results to statistical examination has merely confirmed this opinion.

With the Te Kumi results the response to superphosphate both on the limed and unlimed plots, as compared with the other fertilizers, has been all through very significant. The increases brought about, after allowance made for experimental error, have been as high as 75 per cent. over and above the yields of the areas which received no

GENERAL VIEW OF THE TE KUMI PLOTS.

manure. The increases due to slag and ground rock phosphate have been marked when compared with the controls, but the slight difference recorded between these two last mentioned cannot be regarded with certainty as real.

It must be remembered that the plots were dressed in 1921 and 1922 with the various fertilizers at the rate of 3 cwt. per acre. They were again treated early in June, 1923. As the plots were not shut up for hay in the 1923–24 season, the area was grazed with dairy cows throughout that period, except for one month after 26th October, when all stock were removed and notes made on the pastures of the different plots.

The plots were dressed with fertilizers again on 9th and 10th July, 1924. All stock were removed on 30th September, and the plots cut for hay in the first week of January of this year.

YIELDS OF HAY.

Table 1 gives the yields of hay and other information for the season 1924–25. The residual effect of the fertilizer dressings applied previously has no doubt shown up in the returns given.

Table 1.

Fertilizer used.	Amount per Acre.	Hay-yield per Acre.	Increase over Check per Acre.	Percentage Increase over Check.
Unlimed Plots.		Cwt.	Cwt.	
Check	No manure	25·5	..	..
Basic slag	3 cwt.	43·7	18·2	71
Superphosphate ..	,,	51·4	25·9	101
Rock phosphate ..	,,	44·6	19·1	75
Limed Plots.				
Superphosphate ..	3 cwt.	47·1	21·6	85
Rock phosphate ..	,,	38·0	12·5	50

As far as weight of hay goes, the plots which were dressed with superphosphate have again shown their superiority over the slag and rock-phosphate plots. In spite of the difference in yields (which may be real) between the super on the limed and the unlimed plots, the apparent superiority of super as against super and lime was not found to be significant when the results were tested statistically. The lower yield indicated was probably due to soil-variation, a fact which was not known or anticipated when the trials were first established. Though rock phosphate would appear to be better than basic slag, the slight difference in yield may not be real. It is interesting, however, to see that ground rock phosphate compares favourably with slag. All fertilizers gave a satisfactory response.

VALUE OF THE HAY.

One may take another view of the observed increases shown in Table 1. Considering them for the season under review, and not attempting to make any allowance for the residual effect of the three applications of fertilizer previous to 1924, the money value of hay provides interesting information. Meadow hay at the time of writing is offered for sale in Auckland at from £7 to £9 a ton. Costing the value of the hay at even £5 a ton, and the fertilizers in each case being delivered at Te Kumi railway-siding (lime costed at 1s. per hundredweight, and 4 cwt. per acre allowed), Table 2 gives some useful comparisons.

Table 2.

Fertilizer used.	Hay Increase over Checks per Acre.	Value of Increase (Hay £5 per Ton).	Cost of Fertilizer (including Freight).	Profit per Acre.
Unlimed Plots.	Cwt.	£ s. d.	£ s. d.	£ s. d.
Check	..	..	..	..
Basic slag	18·2	4 11 0	0 16 7	3 14 5
Superphosphate ..	25·9	6 9 6	0 18 10	5 10 8
Rock phosphate ..	19·1	4 15 6	0 17 9	3 17 9
Limed Plots.				
Superphosphate ..	21·6	5 8 0	1 2 10	4 5 2
Rock phosphate ..	12·5	3 2 6	1 1 9	2 0 9

It will be seen that in every case the use of the fertilizer pays even if only the seasonal cut of hay is considered, apart from the general benefit accruing to the pasture throughout the whole season.

IMPROVEMENT IN PASTURE.

It was mentioned previously that the valuation of the pasture-improvement was based on observations made from time to time by officers of the Fields Division, and also opinions of farmers. The consensus of opinion has been that the plots which received superphosphate and lime possessed the best sward throughout the period of the trials. Just before cutting for hay the following notes were made :—

Superphosphate (on limed area) : Sward dense, vigorous, and of good deep-green colour, due to healthy appearance of cocksfoot, rye-grasses, and bottom growth. Clovers prominent. Weeds not noticeable.

Superphosphate : Considered second to super and lime, but weeds like Yorkshire fog, catsear, dandelion, cud, and tarweed noticeable. Otherwise a good sward, promising a heavy yield.

Slag : Quantity of growth less than on superphosphate plots. Sward is patchy where good grasses and clovers are weak. Colour and density of sward otherwise good, except on patches just mentioned.

Rock phosphate : Sward somewhat disappointing. Bracken fern and weeds obvious. These plots, however, have improved considerably. White clover noticeable and well distributed.

Rock phosphate (on unlimed area) : Pasture poor, though much improved since previous year. Poor colour. Fern and weeds very obvious.

Check (no manure) : These plots look starved. Good grasses holding on with difficulty. Inferior grasses and weeds, including fern, prominent, and have increased since 1921. Stock more or less neglect these plots.

In the autumn and winter the slag plots have each season shown to advantage, having been almost equal in appearance to the superphosphate-lime plots. Only on the unmanured plots does one find grass-stems and other growth dried up and left without being eaten by stock during these periods of the season These latter plots appear brown and starved.

FOUR YEARS' REVIEW.

Table 3 gives the separate weighings of three seasons, and the averages of these since the trials were commenced.

Table 3 (Hay-yields per Acre).

Fertilizer used.	1921.	1922.	1923.	1924.	Average of Three Weighings.
Unlimed Plots.	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
Check	23·5	22·4	Not cut for hay.	25·5	23·8
Superphosphate ..	41·2	44·3		51·4	45·6
Basic slag	29·1	35·8		43·7	36·2
Rock phosphate ..	29·3	32·5		44·6	35·4
Limed Plots.					
Superphosphate ..	41·6	38·6		47·1	42·4
Rock phosphate ..	27·4	27·6		38·0	31·0
Rainfall at Te Kuiti ..	56·8 in.	53·85 in.	51·87 in.	71·46 in.	..
Number of rainy days ..	166	161	168	179	..

The average rainfall for Te Kuiti over a ten-year period is 60 in. These records were kindly supplied by Mr. J. N. Hamlin, Bank of New Zealand, Te Kuiti, to whom thanks are due.

COMMENT.

(1.) The response to all phosphatic fertilizers at Te Kumi is marked.

(2.) On a basis of odds of 30 to 1 (which is considered practical certainty), slag and ground rock phosphate have given yields of about 40 per cent. over and above the check plots. While the improvement brought about by these fertilizers is very satisfactory, they only suffer by comparison with superphosphate. Super appears to be the most profitable fertilizer to use where conditions are similar to those at Te Kumi.

(3.) Results so far show no differences between slag and rock phosphate which can be considered real. Only further results gained by repetition of these trials can give the answer. The same can be said in reference to the Pukekohe and Parakai trials. Attention is drawn to the progressive improvement recorded each year in the hay-yields from slag and rock phosphate since the trials were started at Te Kumi. This improvement is also shown from inspection of the pasture.

(4.) Since rock phosphate compares favourably with slag, the practice of using a mixture—slag or rock phosphate with superphosphate—is a sound one. While it is almost a general experience in New Zealand and elsewhere that lime combined with ground rock phosphate tends to lower the yields of crops, the opposite is generally true when lime is used with superphosphate. The explanation offered for the slightly decreased hay-yields at Te Kumi is most probably the soil-variation, which we now know generally favoured the unlimed plots. In spite of the soil factor, however, the best sward from a grazing point of view is seen on the super-lime plots, where clover-growth is exceptionally good. Super alone tends to stimulate the grass-growth and weed-growth, all of which shows up in the weights of hay taken.

(5.) After further weighings are made at Te Kumi and the other areas, more available evidence will allow of even more definite conclusions to be drawn. However, the convincing evidence so far of the value of top-dressing pastures with phosphatic fertilizers makes one wonder why any farmers neglect such a ready, profitable, and sure means of improving their grassland.

I wish to thank Professor P. W. Burbidge, of Auckland University College, for his assistance with the statistical examination of the results, and also Mr. G. A. Holmes, M.Sc., B.Ag., of Ruakura Farm of Instruction, who checked the results at Te Kumi. My thanks are also due to the members of the Fields Division, Auckland, and to Mr. Charles Harrison, Te Kumi (owner of the property on which the plots are located), whose co-operation and help have been freely given.

The individual plot yields will be gladly supplied to those interested in the full records of these trials if application is made to the Department of Agriculture.

IMPROVED STRAINS OF NEW ZEALAND OATS.

COLLEGE ALGERIANS, DUNS, AND DANISH.

F. W. HILGENDORF, D.Sc., Biologist, Canterbury Agricultural College, Lincoln.

IN 1910 the Board of Governors of Lincoln College undertook the work of improving the wheats of Canterbury, and during the following ten years succeeded in producing College Hunter's, College Tuscan, and College Velvet, all improved strains of the standard varieties. A start had also been made on the selection of Algerian oats. By 1920 the work of maintaining the purity of these strains was taxing the slender resources of the College, and the Department of Agriculture made a grant of £500 a year towards the expenses of further improving wheats by cross-breeding, and of improving other standard varieties of oats by selection. The crossing of wheats has not yet produced grain for farmers' use, but the selection of oats has had results worth putting on record. Four varieties were used for selection—namely, Algerians, Gartons, Duns, and Danish.

ALGERIANS.

The strain A86, reported on in this *Journal* for March, 1923, has been on the market since that date under the name of College Algerians. It has obtained a considerable degree of favour, as is evidenced by the facts that in the sowing season just passed the seed was quoted in market reports at 6d. per bushel above ordinary seed, and that two Canterbury firms between them sold 20,200 bushels of seed, of which 3,000 bushels were for the North Island. The reports received indicate that the strain has maintained a superiority of about 10 per cent. over unselected seed.

GARTONS.

In the variety locally known as Gartons, but elsewhere as Garton's Abundance, the selection has failed to disclose a strain superior in yield to the commercial seed already on the market. This is probably because Abundance is the subject of continuous careful selection by Messrs. Garton in England. It is notoriously difficult to strike an improvement in a variety produced by good mass selection; while if the original selection has been pushed so far as to produce a pure line, then all future selection—so long as the line remains pure—must be quite without result.

DUNS.

A selection has been made from commercial Dun oats, and a pure line bred up from it until a merchantable quantity of the grain has been obtained. This is now on the market under the name of College Duns. All the grain sold under that name is the progeny of a single seed, as the following history of the selection will show:—

1920.—At harvest selected many hundred heads of promising types from a farmer's commercial crop. By further selection in the laboratory reduced these heads to 100, selecting those with most grain,

thinnest husk, least awn, and firmest chaff. In May sowed the seed of each head in a separate row in a bird-proof enclosure.

1921.—Harvested and threshed each row separately, and found that a certain strain numbered A31 was the fourth-highest yielder out of the hundred. This strain and nine others were kept, and in May each strain was sown in a separate plot, the seed obtained from the row being sufficient to sow a plot one-fiftieth of an acre in extent.

1922.—Harvested the ten plots and threshed each separately. Strain A31 was the third-best yielder, producing at the rate of 79 bushels per acre, while the average yield of the other plots was 71·9 bushels per acre. The seed from the three best plots was sown in May in plots in another field, each strain being sown over two plots each one-third of an acre in extent.

1923.—The three strains were threshed separately, and A31 yielded an average of 86·7 bushels per acre, while the others averaged 81·8 bushels. During the years that these first selections had been under trial new selections had continuously been made from farmers' crops, and, by yield trials similar to those described above, had been reduced in number till only the best remained. In May, 1923, five of these newer selections, and the three original strains of which A31 was one, and the best seed that could be bought, were put under a more elaborate trial. Five plots of each of the nine kinds were sown chessboard-wise scattered over a field — making forty-five plots of Duns, each one-tenth of an acre in extent.

1924.—Each of the forty-five plots was harvested separately, and A31 gave the best yield on the average of its five plots. Its yields were 41, 44, 56, 47, and 46 bushels per acre, an average of 46·8, while the commercial seed yielded an average of 44·1 bushels. The best three on this trial were saved and sown in May, 1924, by the half-drill strip method. The fifteen-coulter drill had its middle coulter blocked up, and one-half of the seed-box filled with commercial seed and the other half with the seed of the strain, the drill being then driven wheel on wheel-mark. This method gives alternate plots of the commercial seed and the strain, separated by the absence of one row, as many times repeated as the drill is driven up and down the field. Of each of the three best strains, twelve double plots were thus sown, putting each strain in competition with commercial seed. Each plot was 7 chains long, and it will be seen that great reliance can be placed on the result of such a trial, owing to the length, the number, and the close proximity of the competing plots.

1925.—The strain A31 gave an increased yield over the commercial seed; both the other strains tried also beat the commercial seed, but not so certainly or so constantly as strain A31 did. The twelve double plots were reduced to ten to get rid of the disturbance in yield produced by outside rows, and at harvest each of the ten long plots was divided into three lengthwise, thus giving thirty plots for comparison—that is, thirty plots of the strain and thirty of the commercial seed.

The yields in bushels per acre are shown in Table 1. There is not supposed, by the scheme of the experiment, to be a close similarity between the figures of the first columns when read vertically, as these are records of plots of slightly different sizes and on different soils. The similarity is supposed to be in the differences of any pairs of plots

read horizontally. For instance, the two plots numbered 5 were both large or were on good ground, and so gave a high yield; while the two plots numbered 6 were small or on poor ground, and so gave a low yield. But, since strain and commercial were sown close side by side in each pair, the *difference* in yield is nearly constant—5 bushels in one case and 6 bushels in the other.

Table 1.—Yields of Dun Oat Plots in 1924–25.

Paired Plots Numbers.	Yield in Bushels per Acre.		Difference in Favour of		Paired Plots Numbers.	Yield in Bushels per Acre.		Difference in Favour of	
	Commercial Seed.	Strain A31.	Commercial Seed.	Strain A31.		Commercial Seed.	Strain A31.	Commercial Seed.	Strain A31.
	Bushels.	Bushels.	Bushels.	Bushels.		Bushels.	Bushels.	Bushels.	Bushels.
1	75·5	83·0	..	7·5	17	69·5	71·5	..	2·0
2	85·0	87·0	..	2·0	18	68·0	71·0	..	3·0
3	84·0	89·0	..	5·0	19	72·0	76·5	..	4·5
4	87·0	97·0	..	10·0	20	65·0	66·5	..	1·5
5	90·5	95·5	..	5·0	21	64·5	68·0	..	3·5
6	69·5	75·5	..	6·0	22	69·5	71·5	..	2·0
7	77·0	77·0	..	..	23	66·0	71·0	..	5·0
8	70·0	74·5	..	4·5	24	66·0	64·0	2·0	..
9	66·5	69·5	..	3·0	25	67·0	66·5	0·5	..
10	65·0	71·0	..	6·0	26	83·5	84·0	..	0·5
11	75·0	82·0	..	7·0	27	91·5	91·5	..	..
12	66·5	78·0	..	11·5	28	89·0	93·5	..	4·5
13	75·0	76·5	..	1·5	29	87·5	90·5	..	3·0
14	63·5	75·5	..	12·0	30	86·5	87·0	..	0·5
15	80·0	81·5	..	1·5					
16	76·5	79·0	..	2·5	Aver.	75·0	78·8	..	3·7

Thus in twenty-six out of the thirty trials the strain A31 yielded more than the commercial seed sown in closest proximity to it. The average superiority of the strain was $3\frac{3}{4}$ bushels per acre, or 5 per cent.*

After such a complete trial, in which the strain showed so consistent a superiority over the commercial seed, it was felt safe to conclude that strain A31 was a better yielder than the best seed at the time obtainable, and it was determined to put the strain on the market under the name of College Duns.

From the harvest of 1923 two sacks of seed had been kept, as the small number of plots in that year had conduced to purity of seed. When the 1924 harvest indicated the high promise of strain A31 the two saved sacks of seed were sown in a block in a separate field, and yielded about 93 bushels per acre. Thus when the trials of 1924–25 gave conclusive evidence of the merit of the strain there were available for distribution 350 bushels of seed that had not undergone risk of adulteration in the many plotted trials of the two final years. These 350 bushels were therefore sold to farmers customarily growing Dun oats, and it is expected that the College strain will soon become widely distributed.

* It will be observed that the trial was after Beaven's design, and the calculation of the probable error of the differences made by "Student's" method. Differences were calculated as percentages of commercial: Mean diff. + 4·89 %: σ diff. 4·52 % $\therefore$ Z = 1·08 : N = 30 $\therefore$ by Love's Tables odds > 9,999 to 1.

Summary of Performances of College Duns.

1920–21 : Single row. Third out of one hundred strains.

1921–22 : Fiftieth-of-acre plot. Third out of ten best strains. Yield, 79 bushels per acre ; average of others, 72 bushels.

1922–23 : Two plots, each one-fifth acre. Best of three best strains. Yield, 86·7 bushels per acre ; average of others, 81·8 bushels.

1923–24 : Five plots, each one-tenth acre. Best of nine strains tried. Yield, 46·8 bushels per acre ; commercial, 44·1 bushels per acre.

1924–25 : Thirty plots beside thirty commercials. Superior in twenty-six out of thirty trials. Yield, 78·8 bushels per acre ; commercial, 75 bushels.

Average superiority of strain for four years, 4·4 bushels per acre = 6·6 per cent.

College Duns are indistinguishable from the commercial seed—except, of course, by greater evenness of sample and of growth and maturity. Its response to feeding off in spring has not been investigated, but its very similar habit of growth to that of commercial Duns leads one to expect similar growth after feeding off. The evenness of ripening to be expected in a pure strain has a very advantageous effect in this instance, as the bulk of the crop is ripe before the top grains begin to shake.

DANISH.

The selection of the old Danish variety—once a popular feed oat in Canterbury—proceeded at the same time and in the same manner as in the case of Duns. To avoid wearisome repetition, only the results of the trials will be given, the method of attaining the result being in every case similar to that used with the Duns in the same year. The summary is as follows :—

1920–21 : Single rows. Sixth out of one hundred strains.

1921–22 : Fiftieth-of-acre plots. Second out of ten best strains. Yield, 81·4 bushels per acre ; average of rest, 79·2 bushels.

1922–23 : Two plots, each one-fifth acre. Best of three best strains. Yield, 76·9 bushels per acre ; average of rest, 73·9 bushels.

1923–24 : Five plots, each one-tenth acre. Best of seven. Yield, 45·8 bushels per acre ; commercial, 42·0 bushels.

In 1924–25 the half-drill strip method was used, and, although thirty pairs of plots were sown, various accidents, from drilling to threshing, reduced the strictly comparable pairs to twenty-two. Their yields are shown in Table 2 (on opposite page), comparable plots again being recorded on the same horizontal line. It will be seen that here the strain showed better than the commercial in eighteen out of the twenty-two trials, and although the superiority of the strain was not so constant as in the case of the Duns, yet it is sufficiently convincing.*

* Again Beaven's design of plots and "Student's" calculations were used. In percentages of commercial: Mean diff. $= + 5{\cdot}2\%$: σ diff. $= 6{\cdot}4\%$ $\therefore \frac{M}{\sigma} = Z = \frac{5{\cdot}2}{6{\cdot}4}$ $= {\cdot}81$: $N = 22$ $\therefore$ by Love's tables odds $= 1,500$ to 1.

Table 2.—Yields of Danish Oat Plots, 1924–25.

Paired Plots Numbers.	Yield in Bushels per Acre.		Difference in Favour of		Paired Plots Numbers.	Yield in Bushels per Acre.		Difference in Favour of	
	Commercial.	Strain.	Commercial.	Strain.		Commercial.	Strain.	Commercial.	Strain.
	Bushels.	Bushels.	Bushels.	Bushels.		Bushels.	Bushels.	Bushels.	Bushels.
1	87·0	91·5	..	4·5	13	74·0	73 5	0·5	..
2	92·0	90·5	1·5	..	14	75·0	71·0	4·0	..
3	80·5	87·0	..	6·5	15	76·5	80·0	..	3·5
4	61·5	64·0	..	2·5	16	67·0	67·5	..	0·5
5	66·0	69·0	..	3·0	17	70·0	66·0	4·0	..
6	69·0	87·0	..	18·0	18	61·5	63·5	..	2·0
7	67·5	71·0	..	3·5	19	87 5	90·5	..	3·0
8	67·5	72·5	..	5·0	20	87·5	90·0	..	2·5
9	78·5	82·0	..	3·5	21	85·0	95·0	..	10·0
10	73·0	76·5	..	3·5	22	87·0	95·5	..	8·5
11	67·5	78·5	..	11·0					
12	69·0	73·5	..	4·5	Aver.	75·0	78·9	..	3·9

The average superiority of the strain during the last four years of test was about $3\frac{1}{2}$ bushels per acre, and this was over a mixture of Gartons and Danish, as a pure commercial Danish was unobtainable.

It was therefore decided to offer this strain for sale under the name of College Danish, as a line of about 300 bushels of pure seed had been grown under the same conditions as the pure Duns. This lot has been distributed to farmers usually growing Danish oats, and it is anticipated that the strain will be distributed to wherever the variety is in favour. College Danish is a winter oat of vigorous growth, much like that of Gartons. Its reaction to feeding off has not been tested. It has a rather tall stout straw and bold spreading head. The yield is high, and the grain of a full yellow colour.

GENERAL.

In regard to these strains a word of warning is necessary. We do not say that College Duns or College Danish is a better oat than Algerian or Gartons or any other. What we do say is, If Duns or Danish is the best oat for your land, then College Duns or College Danish will probably give a somewhat better yield than your old seed.

Demand for Light-weight Mutton.—"A review of the prices ruling on Smithfield during the last few years," states the 1924–25 annual report of the Meat Producers' Board, "shows a decided tendency to light-weight mutton. In previous days the difference between light-weight and heavy-weight mutton was a matter of farthings. To-day the difference is pence per pound, so decided and emphatic is the preference for light mutton of good quality. There is always a demand for a limited amount of heavy-weight mutton on Smithfield, which is more than fully supplied from other parts of the world. The quality of this heavy-weight mutton is much inferior to ours. The supply of light, prime mutton from other countries is, however, only limited. We must therefore concentrate on improving the breeding of our flocks, and endeavour to meet the requirements of Smithfield by shipping lighter-weight mutton."

INTERNAL PARASITES OF SHEEP.

LUNG-WORM AND STOMACH-WORM.

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Most farmers are acquainted with the troubles accompanying the infection of sheep with internal parasites, and many have experienced the difficulties to be met with in trying to remedy matters when once they have become firmly established. The trouble is not a new one; it has exercised the minds of flockowners for many years not only in New Zealand, but throughout the world. The diseases specially referred to here are those produced by the lung-worm (*Strongylus filaria*) and the stomach-worm (*Haemonchus contortus*). As these two affections are so often associated, and the methods of prevention, &c., are on similar lines, both will be dealt with together, after giving a short account of the parasites and the symptoms produced. I am convinced that they are the cause of more mortality in the flocks of this Dominion than all other factors put together. The main object of this article is to show that this annual loss is largely preventable, and that a saving of many thousands of pounds could be effected by following the lines suggested.

LUNG-WORM.

The location of this parasite is either in the bronchi or bronchioles of the lungs. The worm is white, with the dark line of the intestine showing along the full length. The male is shorter than the female, and has a caudal pouch; the female tail tapers to a point. The male is 1 in. to 3 in. and the female 2 in. to 4 in. long.

Life-history.—The eggs deposited by the female are hatched in the lung of the host, and are expelled during a paroxysm of coughing, or swallowed and passed in the fæces. The larvæ moult twice during the next few days (the time varies with temperature and moisture), and become infective within probably ten days. They climb up the grass-blades during wet and warm weather, are ingested by grazing sheep, and make their way to the lungs. Symptoms are shown in four to five weeks, when fresh embryos can be recovered from the droppings.

Symptoms.—These may be mentioned for the benefit of the uninitiated. It should be borne in mind that the severity of the attack is in direct proportion to the degree of infestation. The symptom first noticed is a husky cough, during which the animal arches its back in its endeavour to rid itself of the parasites. There is a frothy mucus coughed up, sometimes stained with blood. Death follows from weakness and suffocation. Frequently the stomach-worm is also present, in which case the condition is much aggravated.

Treatment.—Medicinal treatment has not proved very successful, and where large numbers of sheep are troubled it is almost impracticable. Intratracheal injections with various medicaments have been tried, as also treatment by fumigation and inhalations of chloroform. *Nursing* plays the most important part in treatment. Sheep should be removed from wet and low-lying pastures, and placed on the driest to be had, and fed small quantities of dry and nourishing feed two or three

times daily. Crushed oats are good, with the addition of chaff or sound hay. Rock salt should be available, and a plentiful supply of clean water.

Prevention.—This will be much on the same lines as that advocated for stomach-worm.

STOMACH-WORM.

This parasite is an inhabitant of the fourth stomach, and is from ½ in. to 1¼ in. in length. The female is the larger, and has a spiral striping. The eggs produced are voided in the droppings. Under suitable conditions of moisture and warmth they hatch in a few days, and within a fortnight develop into a stage possessing a cuticular sheath, in which state they are able to survive any natural outside condition, including freezing. In a wet paddock or after rain these embryos migrate up the stalks of grasses and are eaten by sheep, when they complete their development in three weeks, and begin to produce eggs to continue ground-contamination. The stomach-worm is found all over New Zealand, but its ravages are most noticeable where there is warmth and moisture, in low-lying undrained areas liable to floods, and particularly where overstocking has taken place. The damage is greatest among lambs and hoggets, whose bodies have less resistance and are more intolerant of injury than those of mature sheep. The system breaks down more quickly from parasitic injury and the poisoning from the secretions and excretions of the parasite. On high country, and where the run is large in area, the parasite has a struggle for existence and the mortality is almost negligible.

Symptoms and Lesions.—When in sufficient numbers the parasites produce anæmia and a general unthriftiness characterized by paleness of the mucous membranes and swellings under the jaw and abdomen. The condition is progressive, diarrhœa supervenes, followed by death. If an infected hogget is killed and the fourth stomach immediately opened the worms are seen (in bad cases) quite readily as a wriggling red mass. If the stomach-contents are emptied out some of the worms will be seen attached to the lining, and on this lining being washed countless punctures are to be seen, one worm making many holes as it moves from place to place.

Treatment.—The greatest factor in successful treatment is a supply of good and nutritious food during the period when treatment is being given, coupled with a change to clean and dry paddocks. In this connection an article by Dr. J. A. Gilruth in 1903, when Chief Veterinarian, may be quoted, as follows: "The great aim of sheepowners should be to prevent the onset of disease, and this can be best done by keeping the sheep in good heart and fettle during the winter months. The superiority of dietetic treatment was demonstrated in the experiments carried out at Moumahaki in the winter of 1895. A mob of seventy lambs in very bad condition and infected by parasites of many species were sent to Moumahaki. For the purpose of the experiment the lambs were divided into four batches. Three batches were put on grass, and each given systematic medicinal treatment. The fourth batch received no medicinal treatment, but were put on good food (young oats and rape), and were given in addition a ration of oats and chaff. The following were the results: Batch 1, intratracheal injections—four died,

and one slaughtered as hopeless; batch 2, dosed with Liq. Arsenicalis (Fowler's solution)—three died, and one slaughtered as hopeless; batch 3, dosed with turpentine and oil—four died; batch 4, good food, no medicinal treatment—no deaths; all improved rapidly."

A medicinal treatment which has proved satisfactory is the use of a 1-per-cent. solution of bluestone, 2 oz. to 3 oz., according to age. Only clear crystals should be used; 4 oz. is dissolved in a pint of boiling water, and water added to make 3 gallons. This will dose over 100 hoggets, allowing for 10 per cent. waste. Only porcelain or enamel ware should be used, as bluestone will corrode metal. This drench should be given after a twelve-hours fast, and the animals treated held in the yards for a few hours afterwards, their droppings being gathered together and burned. The dose should be repeated at intervals of about four weeks. This kills all the parasites, as all the infective stages are swallowed and killed by the monthly dose before they can become mature and lay eggs. No fresh larvæ are hatched out, and the existing ones are killed off.

Prevention.—In no disease is the proverb "Prevention is better than cure" better exemplified than in this one. It is the flockowner's duty to prevent it. When lambs or hoggets become unthrifty, action should be taken at once. Kill one of the animals and find out what the trouble is; do not wait till numbers are affected. The longer treatment is put off, the more difficult will it become and cure be more remote. Young animals are more susceptible than old ones; therefore the first thing is to see that lambs and apparently clean sheep are separated from affected ones, and not exposed to the risk of contact with their manure. The safest paddocks should be theirs. Sunny hill slopes are the best, as they are cleansed by the rains and do not hold the moisture. The largest mortality occurs on the smaller holding, and the greater the carrying-capacity the greater the danger. The large holder, as stated before, has little to fear, as he is usually in a position to supply a change on to clean pasture just as often as desired, and so escapes the risk of a serious infection. Even in his case, however, it is not desirable that he should allow his young stock to graze or drink on wet or swampy areas.

The danger to the smaller farmer is further increased by the fact that he cannot give the essential change, his infestation is much heavier, and his mortality-rate soars if he has not the food available to tide the sheep over this critical period. It is to the small holder that the suggestions offered in this paper are more particularly applicable. The water-supply should be from a reliable source; deep pools and running water are not dangerous, but the edges of shallow pools and marshy ground are to be avoided. Water from wells pumped into troughs is the most suitable.

Drainage is of the greatest importance, as land which is always moist provides the ideal condition for parasitic life. Drainage immediately reduces the number of parasites.

THE FOOD INFLUENCE.

In an American publication some years ago this factor was well expressed in the form of an alliteration: "Permanent Pastures Perpetuate Parasites"; and in an article which appeared in the *New*

South Wales Agricultural Gazette last year this food influence is further stressed as follows:—

It is doubtful if any single factor will do more to counteract internal parasites and their effect than good feeding. Not the quantity but the quality is the important item. Closely associated with this aspect is the best utilization of grazing-land. Undoubtedly, from the anti-parasitic point of view, the subdivision of paddocks is the best course, particularly if each subdivision can be spelled in turn. The longer the paddock can be kept free from stock, the fewer parasites will survive. It is becoming more and more essential to combine agriculture with grazing, and this combination can be made to play its part in lowering the number of parasites. Supposing a cereal crop to have been harvested and wormy sheep to have been put on to eat the stubble and weeds: the sheep will deposit large numbers of eggs on the ground, but it will be ten to fourteen days before any of these eggs will become sufficiently developed to reinfest the sheep. If the sheep are removed and the paddock ploughed the embryos will be turned in and destroyed. Occasionally useful work can be done by burning off paddocks, large numbers of embryos being destroyed. All the measures suggested may not be applicable to all cases, but some at least can be utilized everywhere, and by their adoption and concerted action among stockowners the loss caused by the parasites could be greatly minimized. With closer settlement these methods of prevention will be capable of more general application, and it should be possible to look forward to better control in the future.

ECONOMIC SIGNIFICANCE IN NEW ZEALAND.

In the past practically no records have been kept of the mortality due to these parasites. This year, however, we have been able to get some figures from the Stock Inspectors throughout the country, and these are here tabulated. The figures can only be approximate, and while in some cases they may appear to be overestimated, in others they may be underestimated. The total numbers of sheep and lambs given in the table, and the figures on the next page, are compiled from the sheep returns and agricultural and pastoral statistics of 1924.

Estimated Losses of Sheep and Lambs from Parasitic Worms, Season 1924–25.

District.	Total Numbers (January, 1924, Enumeration).		Losses.			
			Sheep.		Lambs.	
	Sheep.	Lambs.	Number.	Percentage.	Number.	Percentage.
Wellington ..	4,000,000	1,333,000	68,000	1·7	50,654	3·7
Nelson ..	298,000	100,000	5,960	2·0	9,000	9·0
Marlborough ..	743,000	248,000	3,715	0·5	2,480	1·0
Gisborne ..	2,271,000	757,000	31,794	1·4	19,682	2·6
Hawke's Bay ..	2,191,000	730,000	39,438	1·8	18,250	2·5
Taranaki ..	568,000	189,000	2,272	0·4	3,770	2·0
Auckland ..	1,140,000	380,000	28,500	2·5	3,800	10·0
Otago ..	2,143,000	714,000	23,573	1·1	7,854	1·1
Canterbury and Westland	3,340,000	1,113,000	13,360	0·4	15,582	1·4
Southland ..	1,092,000	364,000	4,368	0·4	6,552	1·4
Dominion ..	17,786,000	5,928,000	220,979	1·2	171,824	2·9

Total season's loss of sheep and lambs, 392,803.

NOTE.—The districts specified are those of the corresponding stock inspectorates: Gisborne, for instance, includes the East Cape country round to the Bay of Plenty, while Nelson comprises Collingwood County and parts of Buller County, with areas of low-lying coastal lands.

At 31st January, 1924, there were returned 21,077,684 sheep shorn and 11,133,336 lambs tailed, a total of 32,211,020. At 30th April the total was 23,775,776 sheep and lambs, a decrease of 8,435,244. This is accounted for by slaughter for export, local consumption, weather, &c. Assessing the reduction in lambs from these causes at (in round figures) 5,000,000, and sheep at 3,500,000, we should have, roughly, 18,000,000 sheep and 6,000,000 lambs, being a proportion of three sheep to each lamb. It is from about this period (March–April) onwards that the biggest losses occur from parasitic infection, and my calculations in the foregoing table are based on the figures of sheep and lambs just stated. The table covers one season only, and information collected over a number of years would, of course, be required to establish definite data, as mortality varies from season to season, according to weather conditions, &c. The seriousness of the losses, however, is clearly indicated.

CONCLUSION.

The more important points in the preventive control of these internal parasites may be stressed once again—namely, a clean water-supply; drainage of swampy land; and pasture rotation, with the use of forage crops. Liming, and the ploughing and renewal of inferior sheep-sick grassland, have worked wonders in many cases.

INCIDENCE OF APPLE-CANKER (NECTRIA GALLIGENA BRES.) IN NEW ZEALAND.

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RECENTLY in "Fungous Diseases of Fruit Trees in New Zealand," p. 107, the writer stated that apple-canker was not present in the Dominion, despite the fact that it had previously been recorded by Kirk (*N.Z. Dept. Agr. 13th Ann. Rept.*, p. 412, 1905). This conclusion was arrived at after the examination of approximately 1,500 specimens of cankered apple-branches forwarded to this Laboratory during the past six years by Orchard Instructors and orchardists. These cankers were found to be invariably due to black-rot, fireblight, diplodia-canker, and (rarely) bitter-rot.

Recently, however, specimens of apple-branches were received from Mr. P. Everett, Orchard Instructor, Whangarei, affected with a canker which on close examination was found to differ from black-rot canker, which it somewhat closely resembled. Microscopic examination revealed the presence of both conidia and perithecia of the fungus *Nectria galligena* Bres. These structures were compared with those present on apple-shoots infected with this fungus forwarded by Mr. P. Wiltshire, Imperial Bureau of Mycology, Kew, England, and were found to be identical.

Mr. Everett stated that these cankered specimens were obtained from one orchard, to which the disease appeared to be confined, in the vicinity of Kokako, Whangarei. Owing to its apparent rarity, the writer has not considered it necessary to give details of the life-history of the causal organism, but notes as to the appearance of the

a. *b.*

APPLE-CANKER; NATURAL SIZE.

(*a*) Young cankers; one on right-hand twig showing conidial pustules. (*b*) Old cankers, showing distortion of branch and exposure of wood; perithecia are present on right hand specimen. [*Photos by H. Drake.*

cankers induced by the disease are given to assist diagnosis, so that the extent of the area of infection may be ascertained.

While the cankers resemble closely those due to black-rot, they differ in several details. Young cankers are pallid brown, sunken, and somewhat flattened or distorted, and are delimited by a crevice. The surface is usually studded with small, erumpent, pallid pink or cream, conidial pustules, which give to the whole surface a roughened appearance. As the canker ages, the surface becomes broken up by the appearance of numerous concentric crevices, the disease at this stage closely resembling black-rot, but being separated by the conidial pustules which now appear in the crevices. On a few cankers perithecia are present, appearing as reddish, globose bodies, superficially resembling red-mite eggs.

Thus the non-zoned appearance and presence of conidial pustules separate the young cankers from those due to black-rot, and separation at a later stage may be effected by the presence of conidial pustules (and occasionally perithecia) in the crevices. The distorting habit is also a character by which separation may be effected, but is not infallible in that many cankers do not exhibit this condition.

From old cankers the dead bark frequently flakes away, leaving exposed the underlying dead wood, in this respect differing from black-rot cankers, on which the dead bark usually persists.

Remedial treatment would lie in the direction of prevention of further infection by removal of sources of infection, for this disease cannot be held in check by spraying. Therefore all cankered branches should be removed by cutting several inches below the point of visible infection. The wounds should then be dressed with coal-tar. All cankered wood should be burned and not allowed to lie on the ground.

THE MOWING OF PASTURES AND MANIPULATION OF THE GRASS-MOWER.

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SUCCESSFUL dairy-farming in New Zealand depends very largely on the economical management of permanent-grass land. The aim of the farmer should be to maintain his pastures in such a condition that they throw an abundance of short succulent feed for as long a period as possible. Top-dressing, chain-harrowing, regulation of stocking, subdivision, and the feeding-out of roots and hay on pastures are all excellent management methods for keeping pastures in the best possible condition for milk-production. There is perhaps no means at the disposal of the dairy-farmer for improving his pastures so easy, cheap, and effective as the practice of summer mowing.

PRINCIPLES OF SUMMER MOWING.

In normal seasons most dairying pastures become rank in the summer, and this rank growth is, of course, due to the fact that an average permanent pasture makes about 75 per cent. of its total annual production during the late spring and early summer months. On most intensive dairy farms the farm is usually understocked in the summer-time, and even shutting up a field or so for hay does not allow of sufficiently heavy stocking to keep the rest of the pastures down. It is only on dairy farms of the more extensive type, where the herd is wintered off the dairying pastures, that the summer stocking can be regulated to make the full use of the summer production of grass.

Grasses when they get rank and mature are not as valuable for milk-production as when they are young and the growth short. In other words, the nutritive ratio of the grass widens when the growth gets rank, and from a nutritive ratio of 1 : 5 or 1 : 6 when young they pass to a nutritive ratio of 1 : 9 or 1 : 10 when mature. Cows will produce milk most economically when fed a ration having a ratio of about 1 : 6—that is, the food contains one part of protein to six parts of carbohydrates. It may often be observed in wet summers that the milk-yield falls in January while there is still abundant rank feed in the dairying pastures. The reason for this is that the cows neglect the rank growth, which they seem to know instinctively is unsuitable for them to produce milk on, and continuously graze the patches of grass which they have kept down. So that actually the cows are not getting sufficient food while there appears to be abundant food in the pasture.

A rank growth of grass left on the pasture has a very deleterious effect on the grass sward. Cocksfoot gets very tufted, white clover becomes stunted, and the turf opens up, leaving bare spaces. Perhaps the most detrimental effect of rank-pasture growth is the checking of the white-clover growth, as this is the important element of a pasture which forms the bottom to the sward, keeps the surface of the ground moist, and protects the shallow-rooted grasses. Summer mowing before the rank growth of grass has choked the white clover causes a remark-

able growth of the latter during the autumn. This effect of mowing on white clover can often be seen on lawns; if a section of grass round a house is allowed to grow rank it often assumes a pure cocksfoot stand, whereas on mowing the grass and keeping it close with a lawn-mower the sward often changes to one of almost pure white clover.

HAYING AND MOWING FOR ENSILAGE.

Many of the bad effects of allowing a rank growth to persist in a pasture can be seen in a field that is shut up and hayed in December or January; the rank growth in the summer chokes the white clover, and the aftermath in the autumn usually consists of cocksfoot, the poor growth of white clover being often most marked. In certain respects it would perhaps be better if hay could be saved from special hay crops and not from the average dairying pasture. This is not at all feasible under the present systems of farm-management, but the effect of late haying on a pasture should be recognized, and attempts made to bring back the pasture sward by top-dressing, chain-harrowing, and the feeding-out of roots and hay.

Saving pasture grass for silage aims at cutting a shut-up field in November while the clover-growth is still vigorous and when there are still good prospects of rain falling so that the field will throw good succulent autumn feed. An early-mown pasture usually throws good autumn feed of grass, and the white-clover growth is often most marked.

SUMMER MOWING OF RANK GROWTH.

It is the summer mowing of the rank growth in the dairying pastures from November to February that offers the best opportunity to the average dairy-farmer to improve his pastures. During this period of the year practically all pastures show an uneven, rank growth. Perhaps the best way to commence mowing this growth is to turn into the field all the dry stock on the farm—yearling heifers and the bull. On the first day a quarter or a third of the field should be mown. The stock will eat up all the cut herbage immediately it has wilted. When they have cleaned up most of the cut material another section can be mown, and this be continued till the field is finished.

MANIPULATION OF THE MOWER.

Many mowers on farms are badly neglected, and after a few years' work cut very badly. In many cases the machine is allowed to get out of adjustment through lack of appreciation of the principles on which a grass-mower works. Many people are under the impression that the knife does all the cutting, and confine their attention to the grinding of the knife. In such case, to enable the knife to cut when the other parts of the mechanism are out of adjustment, it is necessary that the horses be worked at a very rapid pace, which is both tiring to the horses and the driver.

Cutting-mechanism.—The cutting of the grass is performed by the blade section and the ledger-plate of the finger-bar, which act as a pair of shears. The finger-bars divide the grass into bunches, and the knife section moving from the centre of one finger to the centre of the next one presses the bunches of grass against the ledger-plates of the finger-bars; the knife section in sliding over the ledger-plate cuts the bunch

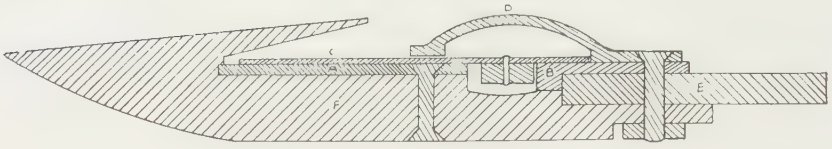

DIAGRAM OF CROSS-SECTION OF FINGER AND KNIFE BAR IN GRASS MOWER.

(*a*) Ledger-plate; (*b*) wearing-plate; (*c*) knife section; (*d*) cap; (*e*) knife-bar; (*f*) finger.

of grass from the rear forwards. For efficient cutting it is obvious that both the edges—the ledger-plate and the knife section—must be both sharp and in close contact. As stated, it is usual to keep the knife sections sharp, but little attention is often given to the edges of the ledger-plates. After a time the edges of these plates become dull and worn. Before putting a mower away the ledger-plates should be greased to prevent them rusting. If the plates are badly worn they should be renewed. Some mowers are provided with fingers having detachable plates; in other machines where the plate is welded in a new finger is required when the edge of the plate becomes worn. The best sharpener for the knife sections is a grindstone, using plenty of water to keep the knife cool.

Lack of contact between the knife section and the ledger-plates is a common source of bad cutting. The same thing is sometimes seen in a shearing-machine hand-piece, where, unless the comb and cutter are brought in close contact, the shears will not cut. Lack of contact between the knife sections and the ledger-plate in a mower is usually due to some of the plates being worn and new plates on some of the fingers raising the knife off the worn ones. When putting on new fingers thin washers are often required to bring them into alignment with the old ones. Sometimes lack of contact is due to the cutter-bar sagging in the middle. The knife is kept from lifting by means of caps; these caps, however, should not be in contact with the knife, but just allow the knife free movement.

Centering.—When the knife is at the end of its outwards or inwards stroke the knife sections should lie in the centre of the fingers; if the sections do not centre the cut is ragged and the draught increased. This defect is usually due to the pitman not being of the correct length. Most metal pitmans allow of adjustment. Another cause of this defect is that the bar is out of alignment, which may have been caused by bending after striking some object, or from continuously cutting round corners. Besides causing bad cutting, a disaligned bar causes severe wear on the knife-head.

Lubrication.—A mowing-machine should receive the careful attention that is due to any valuable machinery. It is fairly easy to keep a machine in good order, but often extremely difficult to set an old machine that has been neglected. Fast-moving parts require plenty of lubrication: the two ends of the pitman should be oiled every few rounds, the gears every half-hour, and the rest of the bearings every yoking-up.

The writer desires to state that his experience of the beneficial effects of summer mowing has been obtained at Ruakura Farm of Instruction, where the practice was commenced a number of years ago by Mr. A. W. Green.

LIMING AND TOP-DRESSING AT WINTON EXPERIMENTAL AREA.

BOTANICAL ANALYSIS OF PASTURE.

R. McGILLIVRAY, F.L.S., Fields Division, Invercargill.

BLOCK 3 of the Winton Experimental Area, on which the investigation here recorded was carried out, was sown in temporary pasture in 1920, the seeding consisting of 40 lb. perennial rye-grass, 6 lb. Italian rye-grass, 2 lb. white clover, and 3 lb. red clover. The block—an area of 5 acres—had been limed as shown in the accompanying plan. In

	A. 1·8 Tons Carbonate of Lime.	B. 3·6 Tons Carbonate of Lime.	C. No Lime.	D. 2 Tons Burnt Lime.	E. 1 Ton Burnt Lime.	Totals.	
Plot 1 ..	152	152	128	184	136	752	Basic slag.
Plot 2 ..	140	144	112	152	128	676	Control.
Plot 3 ..	164	208	124	196	136	828	Basic slag.
Plot 4 ..	144	176	128	152	128	728	Control.
Plot 5 ..	176	188	132	160	132	788	Basic slag.
Plot 6 ..	143	144	128	148	128	691	Nauru rock phosphate.
Plot 7 ..	152	160	144	152	128	736	Control.
Plot 8 ..	132	144	128	148	104	656	Nauru rock phosphate.
Plot 9 ..	156	148	128	148	112	692	Control.
Plot 10 ..	120	144	144	128	104	640	Nauru rock phosphate.

LAY-OUT OF BLOCK 3, WINTON EXPERIMENTAL AREA, FOR LIMING AND TOP-DRESSING EXPERIMENT AND BOTANICAL INVESTIGATION OF PASTURE (DIAGRAMMATIC).

The figures given on the plots represent green weights of herbage in ounces.

July, 1924, basic slag and Nauru ground rock phosphate, at the rate of 3 cwt. per acre, were applied, according to a scheme also shown on the plan. The block was heavily grazed with sheep until 2nd November, when it was closed up for the purpose of investigating the action of the fertilizers and also the botanical composition of the pasture.

MANURIAL RESULTS.

On 26th November an area on each subdivision, commencing at 1A and finishing at 1E, was cut—following on with each plot in a similar way until the final area 10E was completed. The method adopted was to cut an area and weigh a length of 16½ ft. by 4 ft. wide, commencing at Plot 1A. The cutting was performed with a two-horse mower, and was carried to completion under ideal conditions. Green weights were taken in all cases within five minutes after the pasturage was cut. From each weighing a representative sample was taken, each of which was of exactly the same weight. The samples were placed in calico bags and removed to Invercargill, where the contents of each were spread out and air-dried prior to dry-weight determinations and a botanical analysis being undertaken. In the case of dry weights of samples no great variation was found except on the no-lime subdivisions. The loss of weight on all limed and phosphated plots was found to amount on an average to 74 per cent. On Plots 2, 4, 7, and 9, however, where no phosphates had been applied, the loss of weight ranged from 76 to approximately 80 per cent. Subdivisions 2C, 4C, 7C, and 9C all showed a loss of weight slightly in excess of 80 per cent. The basic slag plots proved to have a greater clover content than the Nauru phosphate plots. The latter, however, proved superior in this respect to the controls. One remarkable feature of the analysis of the vegetation was the small weed content of the pasture. In one subdivision only did the weed population amount to over 7 per cent., whereas in quite good pastures weeds of various kinds are often found to amount to 25 per cent. of the total.

It should be mentioned that subdivision E showed the effect of a rather lengthy period of dry weather more than any of the other parts of the field. This somewhat reduced the weights per subdivision, but from a botanical point of view subdivision E was very similar to the others. If the area had not been so heavily grazed up till about three weeks before the investigation was made it is certain the clover percentage in the botanical analysis would have been higher; and results would also have been somewhat different if the examination had been of a permanent-pasture block which had received a seeding of a diversified nature, instead of a temporary pasture with a restricted seeding.

The following table gives a clear indication of average green weights of the manured and control subdivisions under the various dressings of lime :—

		Oz.
Subdivision A :	1·8 tons carbonate of lime, plus basic slag (3 cwt.)	164
,, B :	3·6 tons carbonate of lime, plus basic slag (3 cwt.)	182
,, C :	No lime ; basic slag (3 cwt.)	128
,, D :	2 tons burnt lime, plus basic slag (3 cwt.)	180
,, E :	1 ton burnt lime, plus basic slag (3 cwt.)	134
Subdivision A :	1·8 tons carbonate of lime, plus Nauru phosphate (3 cwt.)	131·6
,, B :	3·6 tons carbonate of lime, plus Nauru phosphate (3 cwt.)	144
,, C :	No lime ; Nauru phosphate (3 cwt.)	133·3
,, D :	2 tons burnt lime, plus Nauru phosphate (3 cwt.)	141·3
,, E :	1 ton burnt lime, plus Nauru phosphate (3 cwt.)	112
Subdivision A :	1·8 tons carbonate of lime—control	148
, B :	3·8 tons carbonate of lime—control	157
,, C :	No lime—control	128
,, D :	2 tons burnt lime—control	151
,, E :	1 ton burnt lime—control	124

The weights per plot under the manurial scheme are given in the following table :—

	Oz.	Average per Plot. Oz.
Basic slag (totals)—		
Plot 1	752	789
Plot 3	828	
Plot 5	788	
Nauru phosphate (totals)—		
Plot 6	691	662
Plot 8	656	
Plot 10	640	
Control plots (totals)—		
Plot 2	676	708
Plot 4	728	
Plot 7	736	
Plot 9	692	

The results revealed are of considerable interest. Basic slag in this investigation stands far ahead of Nauru rock phosphate. If the three slag plots are taken we get a total of 2,368 oz., while the three Nauru plots only gave a return of 1,987 oz. This difference translated into acre proportions amounts to large dimensions. It will be noticed also in the case of the Nauru plots that the immediate controls show a heavier weight than any of the dressed plots. The average weight in the slag plots was 789·3 oz. ; Nauru rock phosphate, 662·6 oz. ; and controls, 708 oz.

It will also be noticed in this connection that subdivision E showed up rather indifferently. The explanation is that the whole of this subdivision was in a drier condition than that of the remainder of the block, and thus although growth was not so prolific it was very even throughout.

BOTANICAL ANALYSIS.

The results of the botanical analysis of the block—based on weights—are shown in the following table, which should be read in connection with the plan :—

	Grasses.	Clovers.	Other Plants (Weeds).
Plot 1.	Per Cent.	Per Cent.	Per Cent.
A	82·60	10·80	6·60
B	82·00	12·10	5·90
C	85·60	8·00	6·40
D	83·20	11·80	5·00
E	83·25	11·00	5·75
Plot 2.			
A	87·00	8·00	5·00
B	86·20	8·85	4·95
C	87·10	6·28	6·62
D	85·80	9·00	5·20
E	86·20	7·95	5·85
Plot 3.			
A	83·45	9·92	6·63
B	83·00	11·86	5·14
C	85·05	8·85	7·10
D	83·45	11·10	5·45
E	85·00	11·10	4·90
Plot 4.			
A	86·25	8·25	5·50
B	85·65	8·95	5·40
C	87·00	7·00	6·00
D	85·90	8·98	5·12
E	85·86	8·48	5·66
Plot 5.			
A	84·04	10·60	5·36
B	83·80	11·49	4·71
C	85·00	8·15	6·85
D	83·00	10·86	6·14
E	83·90	10·05	6·05
Plot 6.			
A	85·20	10·00	4·80
B	84·76	11·00	4·14
C	86·00	8·04	5·86
D	84·10	9·86	6·04
E	84·98	9·82	5·20

BOTANICAL ANALYSIS—*continued.*

	Grasses.	Clovers.	Other Plants (Weeds).
Plot 7.	Per Cent.	Per Cent.	Per Cent.
A ..	85·80	8·00	6·20
B ..	85·00	9·10	5·90
C ..	86·25	6·90	6·85
D ..	85·90	8·40	5·70
E ..	85·15	8·40	6·45
Plot 8.			
A ..	86·20	9·55	4·25
B ..	86·00	10·95	3·05
C ..	86·60	7·80	5·60
D ..	85·00	9·10	5·90
E ..	86·00	9·20	4·80

	Grasses.	Clovers.	Other Plants (Weeds).
Plot 9.	Per Cent.	Per Cent.	Per Cent.
A ..	86·60	7·95	5·35
B ..	86·00	9·60	4·40
C ..	86·95	7·00	6·05
D ..	86·00	8·20	5·80
E ..	86·60	8·10	5·30
Plot 10.			
A ..	86·65	7·95	5·40
B ..	86·25	8·88	4·87
C ..	86·95	6·94	6·11
D ..	86·00	8·66	5·34
E ..	86·16	8·42	5·42

The weed-plants present in the pasture were curled dock, hedge-mustard, sorrel, sow-thistle, chickweed, catsear, scarlet pimpernel, persicaria, Scotch thistle, and self-heal.

VARIATIONS IN THE PERCENTAGE OF BUTTER-FAT IN MILK.

(Concluded.)

V. SUMMARY OF THE INVESTIGATION.

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Concluding this investigation, it is patent that the percentage of butterfat in milk is a complexly variable quantity, subject to influence by quite a number of factors. In some instances these causal factors are interdependent, and thus make it difficult to isolate the effects of any particular one. It is not always possible, therefore, to eliminate the probable effects of such extraneous factors, and for this reason some results have superimposed upon them the combined effects of other factors. Moreover, on many points of interest cow-testing data do not supply particulars, and thus are limited in application for purposes of investigating all phases of test fluctuation. To fully cover all features an investigation of this nature obviously requires to be supplemented by specially controlled experiments. Notwithstanding these limitations, results of a very useful nature have been obtained. Exceptions are due in the most part to peculiarities of the individual; and, since individuality within a breed is responsible for more variability than that of breed itself, it is little to be wondered at that they have been met with. The underlying principles which govern test variation are best represented in average or normal cases. The conclusions, therefore, have been deduced as much as possible from this basis, and, although not invariable, represent general tendencies which naturally are of greatest importance.

Test variations have been summarized under three main headings—namely, daily, monthly, and yearly. The operating factors responsible for the variations are enumerated under the respective headings.

DAILY VARIATIONS.

No C.O.R. data were available for investigating this phase of test variations, and the second article of the series was more of a precis of the findings of many investigations. No acknowledgments of the various sources of information were made, since the number of references would necessarily have been very numerous. However, the writer would here express his thanks to the many investigators to whose works he made reference. As a summary of this phase of test variations the position could not be better stated than by adopting the conclusions given in Article II :—

(1.) Provided that milking in every case is complete and that the variations in milk-yield are not of an extreme nature (otherwise the rule may or may not apply), the daily test varies inversely, to a certain extent, with the milk-yield.

(2.) Whenever the daily test is influenced by any means it soon tends back to normal, and usually in so doing swings slightly past normal in the other direction before finally coming to rest.

(3.) Where cows receive good feeding and attention the test cannot be permanently raised by any appreciable amount by the use of special foods.

MONTHLY VARIATIONS (C.O.R. DATA).

Breed : Red Poll, Ayrshire, Milking Shorthorn, and Friesian monthly tests, in average cases, decrease for a few months after calving, and then increase gradually to the end of the lactation period, the final test being about 20 per cent. higher than the first. On the average, Jersey monthly tests increase right throughout a lactation and finish at about 35 per cent. more than the first test. The range in variation between the lowest and highest monthly tests of the other breeds amounts to about 25 per cent. of the annual test.

Time of year of calving : The first and final monthly tests are generally highest for cows commencing their lactation period in late autumn or winter, and lowest for those calving in late spring or summer. Furthermore, cows test highest and lowest respectively during these periods irrespective of the month of commencement. The percentage range of variation between tests for the two periods lies roughly between the limits of 5 per cent. and 10 per cent.

Length of period of gestation during lactation : The longer a cow is non-pregnant during a lactation period the lower are the final monthly tests ; the lowering of the final tests ceases for longer fallow periods than about seven months and a half, the final test being then nearly as low as the first. In other words, a cow may be pregnant up to about four months and a half during a 365-day lactation without this affecting the monthly tests or their trend of variation.

Nature of season : The general rule is that the monthly tests are slightly lower than the average following wet periods, and slightly higher following dry ones, the percentage variation from the average being rarely more than 5 per cent. for any one month or 2 per cent. for all months.

Age: The general trend of monthly tests for varying ages remains uniform, the various curves being above, below, or coincident with the average curve for all ages.

Quantity of milk-production: Difference in quantity of annual milk-production seldom affects the general trend of monthly tests, but where individual monthly milk-yields vary much from the average the tests vary inversely. (Note: For entirely pasture-fed cows rainfall is the principal cause of variation in monthly milk-yield.)

YEARLY VARIATIONS (C.O.R. DATA).

Breed: To illustrate the range in variation in test due to breed, the average tests for the various breeds reduced to percentages of the average Jersey test are as follows: Red Poll, 79 per cent.; Ayrshire, 74 per cent.; Milking Shorthorn, 72 per cent.; Friesian, 64 per cent. The maximum range of variation in test within each breed is approximately 60 per cent., whereas that in annual milk-yield is about two and a half times this amount.

Time of year of calving: The annual tests are highest for cows calving in late autumn or winter, and lowest for cows calving in late spring or summer, the percentage difference in average cases ranging up to about 5 per cent.

Length of period of gestation during lactation: The longer a cow is non-pregnant during a lactation period the lower the annual test, the annual test reaching a minimum for a fallow period of about seven months and a half or more following freshening. In other words, a cow may be pregnant up to about four months and a half during a 365-day lactation without the annual test being influenced in any way. On an average, the range in variation between the extremes is in the region of 5 per cent. The extremes are: (1) Cows pregnant immediately following freshening—in which case the lactation period is nine to ten months only; (2) cows conceiving seven months and a half or more after commencement of a lactation.

Nature of season: The annual test is lowered slightly for a wet season, and raised slightly for a dry one, the percentage variation from the average being rarely more than 2 per cent.

Age: As age advances after first calving the annual test decreases gradually by small amounts for about ten lactations, and then appears to rise somewhat, the total range in variation being roughly 6 per cent.

Quantity of milk-production: The test varies inversely to a slight extent with the milk-production, being more noticeable when the latter varies below than when it varies above. The rate of variation in test is not constant, and increases toward the milk-yield extremes, especially toward the lower one. The range in test variation for extremes of milk-yield variation amounts to something like 20 per cent. The range of variation for normal cases is, however, considerably less than this amount. A rough rule is that the test varies inversely with quantity of milk-production in the ratio of 1 : 8; for example, if the quantity of milk is 8 per cent. above the mean the test will be 1 per cent. below the mean, and *vice versa*.

PRACTICAL APPLICATION.

For the purposes of practical application the results of this investigation have been linked with a few suggestions. These are given under three headings, according as they interest different sections of the dairying community.

Points for Suppliers of Dairy Factories.

The main object of the supplier of milk to dairy factories is to obtain as much butterfat as possible from each cow. To fully achieve this objective the cow must be 100 per cent. efficient—that is, she should be producing butterfat to the full extent of her capacity. In other words, a cow should be handled in such a manner that the highest possible quantity and quality of milk are obtained at all times. The following hints should be helpful in attaining the latter object at least :—

(1.) The operation of milking should be skilful, fast, and, above all, complete. This ensures both a richer and greater quantity of milk being given.

(2.) A cow should be " brought in " in good condition, and so maintained as much as possible throughout the whole lactation period.

(3.) From the point of view of butterfat-production the best time of freshening is autumn or early winter. Not only is a higher annual test obtained, but also a longer lactation period, this tendency to milk longer being greatest for cows commenced in June or July. According to an American investigation, this period of commencement also gives a higher income over cost of feed (United States Department of Agriculture Bulletin No. 1071). This finding might or might not exactly coincide with results of a similar investigation here, since winter feeding there has to be specially provided for to a much greater extent than in New Zealand. The owner would require to decide whether advantage gained in butterfat-production by autumn or early winter calving warranted the extra costs for feed, attention, &c.

(4.) The lactation period should be maintained as long as possible during the year, provided such is consistent with profitable butterfat-production. The efficiency of the cow as a butterfat-producer varies during a lactation, and the period should be terminated (with the possible exception of two-year-olds) as soon as economical production is no longer possible.

(5.) A cow should be treated kindly, be fed and milked at regular hours, have plenty of clean water, be protected from extremes of weather, have exercise and fresh air, and be kept as far as practicable from all forms of excitement, injury, and sickness.

For Dairymen supplying Milk for Human Consumption.

Dairymen who supply milk for human consumption aim to obtain as much milk as possible from their cows, and at the same time during the whole season keep the percentage butterfat content of the herd milk above the minimum required by law. To conform to the

latter requirement regular testing is essential, more especially if the breed used is a low-testing one. A product of more uniform quality may be obtained by having cows freshen at different periods of the year. Furthermore, this practice tends to keep the quantity of milk fairly constant throughout the year. To avoid variation in quality of milk where separate deliveries are made from each milking, morning and evening milkings should be made as far as practicable at equal intervals. Other more or less minor variations may be avoided by adhering to the general rules set out in the preceding paragraph. Maximum annual milk-production is obtained by commencing cows in autumn or early winter.

For the Breeder of Purebred Dairy Cattle.

The breeder of purebred dairy cattle is anxious to obtain good records for his stock. Not only should the butterfat-yield be high, but also it is a popular desire that the test should rank high for the breed in question. Quality of milk is recognized as a hereditable factor, and thus breeders are aiming by means of selection to fix high-testing ability. Although a cow may have inherited this characteristic, it will remain more or less of an unknown quantity in breeding unless it has been developed and ascertained to its full extent beforehand. To facilitate its full development the operation of milking should be skilful, fast, and absolutely complete. In addition, the cow should be "brought in" in good condition during late autumn or winter, and freshenings be at intervals of not more than twelve months. In order to ascertain the extent of high-testing ability present a cow should be tested as early as possible—preferably as a two-year-old—under the conditions outlined. Under these conditions a cow should test as high as she is capable of. The only reliable guide to the test in this case is the "annual test," or average test for the lactation period. This is ascertained by dividing 100 times the annual butterfat by the annual milk figures. Before fair selection is possible the records for all animals from which selection is being made should have been made under similar conditions.

Since quality varies inversely with quantity of milk-yield to appreciable amounts only when the quantity falls well below the average, quantity of milk-production could be aimed for conjointly with quality without the former object in any way defeating the latter. By adhering strictly to this system, coupled with suitable selection and line or occasional careful inbreeding, it should be possible to found, in the course of a few generations, a high-testing strain the majority of individuals of which are prepotent for this characteristic.

The Late Mr. A. J. Faulkner.—We note with great regret the recent death of Mr. A. J. Faulkner, of Muriwai, Poverty Bay. Mr. Faulkner was a very progressive farmer, and his fine property "Wairakaia" gave him good scope in both the pastoral and arable branches of agriculture. His various contributions to the *Journal* in past years were much appreciated for their practical value. Mr. Faulkner did much good helpful work in a quiet way, and his loss will be felt by many in the district, especially among the soldier settlers.

MARTON EXPERIMENTAL AREA.

NOTES ON OPERATIONS, 1924–25 SEASON.

J. M. SMITH, H.D.A., Assistant Instructor in Agriculture, Wanganui.

IN common with the rest of the Wellington west coast, the Marton district experienced an exceptional season during 1924–25 as far as weather conditions were concerned. This applies more particularly to pastures and fodder crops, although the returns from grain crops, on comparing these with the previous year's results, show that this past season suited them well also. A fairly mild, dry winter was followed by a good spring, perhaps a little on the wet side early, but extremely dry towards November. The midsummer was one of the wettest experienced for a number of years, and this seriously interfered with harvesting generally. Genial weather was experienced during the autumn, the latter part of which, however, had more than its usual share of cold southerly snaps. Details of the rainfall are as follows :—

1924.	Inches.	Wet Days.	1925.	Inches.	Wet Days.
July	2·76	11	January	3·23	6
August	2·45	9	February ..	2·16	9
September	3·33	18	March	1·85	8
October	4·73	16	April	0·99	10
November	1·45	9	May	5·02	18
December	8·14	19	June	3·77	18

The total rainfall for the season was 39·88 in., with 151 wet days.

SCHEME OF WORK.

It was pointed out in last year's report (*Journal*, September, 1924) that a great deal of the cultivated land in the Area had been put down in pasture with a view to carrying out top-dressing trials, which phase of farming along this coast is becoming extremely important in view of the conditions which nearly always follow the breaking-up of the land for cropping—namely, the invasion of weeds (particularly Californian thistle) and various pests and diseases. The area under crop during the past season was greater than that of the previous season, as two of the older pasture-paddocks were ploughed up. One had outlived its usefulness, and the other had a heavy growth of clover, which was turned under for the purpose of building up the soil-fertility. The crops grown were as follows : Wheat, 14 acres ; oats, $2\frac{1}{4}$ acres ; barley, 4 acres ; peas, $3\frac{3}{4}$ acres ; tares, $\frac{1}{2}$ acre ; and fodder crops, 10 acres—a total of $34\frac{1}{2}$ acres. The balance of the Area, with the exception of the lucerne and clover plots, was down in grass, of which 18 acres were under trial for top-dressing.

WHEAT VARIETIES.

A variety trial with wheat was conducted in Field 6, the varieties under test being Queen Fair, Queen Fan, Turretfield Eclipse, Jumbuck, and Zealand. The plots were each 1 acre in area. The wheat was pickled and sown on 10th October, seeding being at the

rate of 2½ bushels, and the manure used 2 cwt. superphosphate per acre. During the growing-period it was noticed that the Zealand variety was a very strong stooler and gave every indication of being a good fodder wheat. The crops were harvested during February, the different varieties reaching maturity as tabulated.

Table 1.

Variety.	Date cut.	Yield per Acre. Bush.	lb.	Remarks.
Queen Fair ..	17/2/25	42	50	A little rust ; inclined to lodge ; medium straw.
Jumbuck ..	6/2/25	41	58	No rust ; stood well.
Queen Fan ..	17/2/25	41	42	Very little rust ; inclined to lodge.
Turretfield Eclipse	9/2/25	38	21	Badly rusted ; stood well ; short straw.
Zealand ..	19/2/25	21	43	Badly rusted ; badly down ; fine straw.

Birds were very severe on Zealand even before the other varieties were cut, although Zealand was then still quite green.

A further 9 acres were put down in two varieties of wheat—5 acres of John Brown and 4 acres of Major. A manurial trial was carried out on this area between superphosphate and a proprietary grain manure. A strip was sown through the middle of each variety with grain manure, and the balance sown with superphosphate ; hence each strip with grain manure was bounded by the same variety of seed, but sown with superphosphate. The seed was treated with formalin and sown at the rate of 2½ bushels per acre on 4th October. The manure in each instance was applied at the rate of 2 cwt. A storm on 17th December played havoc with the John Brown over both manurial plots, and great patches throughout the crop went down. Major, on the other hand, was not affected. The John Brown was cut on 31st January, and Major on 11th February. The plots threshed out as follows :—

Table 2.

Variety.	Manure.	Yield. Bush.	lb.	Remarks.
John Brown ..	Superphosphate..	29	21	Badly down ; a little rust.
,, ..	Grain manure ..	32	0	,, ,,
Major	Superphosphate..	38	24	Stood well ; clean.
,, ...	Grain manure ..	38	3	,, ,,

BARLEY, PEAS, AND VETCHES FOR THRESHING ; VARIOUS FODDER CROPS.

Black Skinless barley and Early Minto peas were both sown in the wettest paddock on the Area, and this, together with the late date at which they were sown and (especially in the case of the peas) the wet conditions at harvesting-time, reduced the yields considerably. The peas in particular were lying cut for nearly five weeks, during which time they were turned several times on account of the wet

weather. Half an acre of William Hurst peas and the same area of Moumahaki vetch were harvested late, and at time of writing are still in the stack.

Ten acres were put down in ten 1-acre plots of various fodder crops, but owing to late sowing, followed by dry conditions, the growth made by the various crops did not warrant the carrying-out of the tests, and the area was grazed off without any weights being taken.

FIG. 1. PLOUGHING UNDER HEAVY GROWTH OF CLOVER AND RYE-GRASS IN FIELD 8, MARTON EXPERIMENTAL AREA.

FIG. 2. BARLEY HARVEST IN FIELD 7 AT MARTON.

WILD WHITE CLOVER.

The imported wild white clover plot is now practically covered, and the clover has thoroughly established itself. It was not feasible to keep a separate tally of the stock this plot carried, but it was heavily stocked for fairly long periods at a time. In the autumn a seed crop was saved, but not without a great deal of trouble on account of the adverse weather conditions. A further half-acre of colonial white clover was sown on 5th December in close proximity to the wild white, and this has already established itself fairly well During next season a comparison between the wild white and the colonial white will be made, when some interesting data should be forthcoming.

PASTURE TOP-DRESSING AND GRAZING TRIALS.

As mentioned previously, the pastures did remarkably well during the past season. An instance of this is shown in Field 1, where 11 acres of temporary pasture sown in April, 1921, and partially top-dressed in the winter of last year, carried just six sheep to the acre for the past twelve months—this, moreover, in addition to providing a hay crop. The top-dressing trial carried out on this area was one between the ordinary Nauru phosphate and a specially finely ground Nauru phosphate. The ordinary Nauru phosphate is fairly slow in its action, and it was thought that by grinding it up to an extremely fine powder it might become available to the plant much more quickly. Four and a half acres were pegged off in nine half-acre plots, each plot being 11 yards wide. The two different classes of Nauru were applied alternately to every other plot, the remaining plots being left as controls. Thus every manure plot had a control or untreated plot on either side of it. The manure was applied on 6th June, 1924, at the rate of 3 cwt. per acre. On 25th October the area was shut up for a hay crop, and this was cut and weighed on 8th December. Special precautions were taken in the cutting and weighing of the plots to ensure, as far as possible, that each plot should be weighed in sections immediately after the mower, to save any difference that might have occurred through evaporation. In compiling the results only neighbouring sections were compared, so that any difference due to soil-variation was eliminated as much as possible in the final results. The results were as follows, the average weights of green material from the various like plots being given :—

Table 3.

Manure.	Average Yield.	Average Yield of Controls.	Increase due to Manure.
	Tons cwt.	Tons cwt.	Cwt.
Ordinary Nauru phosphate ..	4 14	3 16	18
Special Nauru phosphate	4 6	3 18	8

The 13 acres of young temporary pasture carried 2·44 sheep per acre for the past season, in addition to providing two hay crops.

This meant that the nine months of grazing available did not include the period of greatest growth. The top-dressing trial with the two grades of Nauru was repeated on this area, the plots being treated in the same manner as described in connection with the previous area. The paddock was shut for a hay crop on 29th October, and the crop was cut and weighed on 1st December. There was a splendid aftermath of clover, and it was decided to take a second crop of hay. This was weighed on 29th January. The two crops resulted as follows, weights given being the average green weights from the various like plots :—

Table 4.

Manure.	First Crop.			Second Crop.		
	Average Yield.	Average Yield of Controls.	Increase due to Manure.	Average Yield.	Average Yield of Controls.	Increase due to Manure.
	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.
Ordinary Nauru	9 16	9 0	0 16	8 5	7 3	1 2
Special Nauru ..	9 8	9 0	0 8	8 5	7 3	1 2

The small permanent pasture near the school was again top-dressed last year, and a hay crop taken off in December. The fertilizers applied and the green weights per acre are as shown in the following table :—

Table 5.

Plot.	Manure.	Date applied.	Hay-yield (Green Weight).
			Tons cwt.
1	Lime, 1 ton ; superphosphate, 2 cwt.	9/8/21	5 17
	,, ,, ...	11/8/24	
2	Bone-char, 4 cwt.	9/8/21	3 10
	Special Nauru, 4 cwt.	11/8/24	
3	Walpole guano, 4 cwt.	9/8/21	4 10
	Ordinary Nauru, 2 cwt.	11/8/24	
	Special Nauru, 2 cwt.	11/8/24	
4	Nauru, 4 cwt.	2/9/22	4 3
	,, ...	11/8/24	
5	Control (no manure)	..	2 1
6	Basic slag, 4 cwt.	14/7/21	4 7
	,, ...	11/8/24	
7	Nauru, 4 cwt.	14/7/21	3 19
	,, ...	11/8/24	
8	Ephos, 4 cwt.	14/7/21	3 17
	,, ...	11/8/24	

LUCERNE.

The lucerne stand gave three cuts during the season. This area is showing an inclination to go into grass, and will be limed and top-dressed in the spring with a view to increasing the amount of lucerne. Results for the past five seasons, in conjunction with the

various methods of sowing, are as follows (weights given being of green material) :—

Table 6.

Season.	Number of Cuts.	Broadcast.		7 in. Drills.		14 in. Drills.		21 in. Drills.	
		Tons	cwt.	Tons	cwt.	Tons	cwt.	Tons	cwt.
1920–21	3	17	0	17	5	17	0	14	14
1921–22	4	25	10	19	14	22	12	21	8
1922–23	3	18	15	17	13	18	4	16	12
1923–24	3	15	15	14	17	14	4	13	6
1924–25	3	18	7	15	14	17	18	15	4
Average ..	..	19	1	17	0	17	19	16	5

GENERAL.

The carrying-capacity of the whole Experimental Area (including the pastures already mentioned) was just over two sheep to the acre for the season.

During the 1925–26 season a further area of unimproved adjoining land will be acquired, and this will be laid off in plots and top-dressed with various manures to ascertain what improvement can be made in the poor pasture already in existence, without breaking up the land. The top-dressing trials in operation will also be further carried on.

FARMERS' FIELD-CROP COMPETITIONS.

MAUKU AND PATUMAHOE DISTRICTS.

C. J. Hamblyn, B.Ag. (N.Z.), Assistant Instructor in Agriculture, Auckland.

Mangolds have been grown successfully for many years in the Mauku and Patumahoe districts, but, although the soil and climatic conditions are fairly uniform, no uniformity exists among the farmers as to the varieties grown, the type and amount of fertilizer used, the time and method of planting, and so forth. With a view to fostering interest in mangold-growing, and, above all, gaining useful local information as to varieties, manures, &c., most suitable to the district, the Mauku Branch of the Farmers' Union this year organized a competition on the lines of the successful competitions held in the Taranaki, Wanganui, and Feilding districts.

The Branch has presented a handsome challenge cup, to be won outright by three wins in succession or five times at intervals, together with a gold medal to be retained by winners of the cup. The local agents of Messrs. Sutton and Sons have presented a gold medal for the grower of the best crop with Sutton's seed. The competition is for the best half-acre of mangolds of any variety grown by a farmer on his own property. Special forms are supplied on which the farmer is required to fill in details of cultivation, variety, amount of seed, manuring, method and time of planting, after-cultivation, &c.

The first competition was judged by the writer on 5th and 6th May last, and the cup and trophies were presented at a social gathering on 23rd June. A feature of the competition is that farmers are encouraged to accompany the judges round the various crops and enter freely into discussions of the merits and demerits of the crops under review. In this way much useful information is exchanged. Again, at the social gathering another opportunity is afforded the farmers of gaining further information, when the competition as a whole is discussed by the judge and comments passed on the crops in detail.

This season twenty entries were received, and of these thirteen were finally judged. In order to save time (only one judge being available), after a careful inspection of all the crops six outstanding crops were selected, and these were weighed and judged. For the purpose of gaining information as to the average weight of crops in the competition, and also the average of each variety grown, it is hoped to be able to weigh every crop next season. Altogether the competition has already proved a marked success, and it is to be hoped that other districts in the Auckland Province will take up the organization of similar field-crop competitions.

The heaviest crop in the Mauku competition this season was grown by Mr. J. Malcolmson. This was a good crop, the half-acre being made up of two-thirds of Jersey Queen and one-third Yellow Globe, averaging a yield of 54 tons per acre. The width between rows was 24 in.; manure, 10 cwt. mangold-fertilizer per acre. The second heaviest crop was one of Red Intermediate—53½ tons per acre—grown by Mr. A. Ashford; width between rows, 24 in.; manure, 7 cwt. per acre of mangold-fertilizer. The third heaviest crop, that of Messrs. Rowe Bros., yielded 51½ tons per acre; it was grown in 30 in. rows, with 15 cwt. of manure consisting of a mixture of kainit, superphosphate, and root manure in equal parts. This crop gained second place, being of much better quality and type than the heavier crop grown by Mr. Ashford.

All the crops judged were transplanted from special beds, or from a few rows in which all the seed was grown. This method allows, it is claimed, a free use of implements in the eradication of annual weeds before the crop is planted; and some very clean crops were seen on which no after-cultivation had been done, all the weeds having been got rid of previous to the transplanting. However, even where no weeds are present the necessity for after-cultivation is just as important as it is when the seed is drilled in the usual way.

Top-dressing of Sheep Pastures.—The third annual report of the New Zealand Meat Producers' Board remarks: "The great increase in the output of dairy-produce during the last ten years has been largely brought about by the top-dressing of pastures. The top-dressing of our sheep pastures will do the same for our meat and wool industry. A start has been made in some districts, with wonderfully good results. As much of our sheep-country is hilly and broken, top-dressing has to be done by hand, but experience has already proved that where the country is not too broken or inaccessible this can be done at moderate cost for labour."

SEASONAL NOTES.

THE FARM.

GRAIN CROPS.

SPRING-SOWN grain crops require a heavier seeding than those sown in autumn. Wheat and barley should be sown at about 2½ bushels and oats 3 bushels to the acre. Where the area is small and birds are numerous these quantities can be increased by ½ bushel per acre with safety. Great care should be taken not to spill any grain about the headlands, as this is a great attraction for birds. If they are troublesome it is a good plan to follow the drill and broadcast a little poisoned grain. Unless the land is very rich, all grain crops sown at this time of the year should have from 1 cwt. to 2 cwt. per acre of superphosphate or a similar amount of reliable grain manure. With the exception of very strong land the final feeding-off of autumn-sown crops should be completed during the coming month.

PEAS AND TARES FOR THRESHING.

Crops of peas and tares intended for threshing should be got in towards the end of September or early in October. Peas for lamb-fattening sown about the middle of October will be early enough in most situations. Peas should be sown at the rate of 3 bushels and tares 2½ bushels per acre. Dairy-farmers with land available cannot do better than sow 2 or 3 acres of peas for pig-raising in the autumn and winter; there is no crop pigs will thrive on better. Both peas and tares are lime-loving plants, and, where at all possible, land intended for these crops should have a dressing of 5 cwt. to 10 cwt. of lime per acre. Basic super, basic slag, or super are suitable manures. Early Minto, Grey partridge, and Imperial blue do well generally. Early Minto is rather earlier than Grey partridge, and is the heavier yielder.

ROOT CROPS AND ROTATIONAL PRACTICE.

The preparation and cultivation of land for root crops should now be pushed along.

In many farms in Southland and south Otago it has become a common practice to grow two or more turnip or swede crops in succession. The fact should be emphasized that to crop in this manner is to court trouble, as club-root is becoming increasingly prevalent and becomes worse with each succeeding crop. At time of writing it would appear that quite a number of fields now in turnips in these districts will be sown in the same crop this season. The old practice in Southland was for oats to follow turnips, but this is not adhered to so generally now. Farmers would be well advised to grow a special hay crop, such as oats and peas, after turnips. A mixture of 2 bushels of oats and 1½ bushels of partridge peas will give good results, especially if helped along with 2 cwt. of super per acre. The oats and peas for hay, if sown in September, would be ready to cut about the middle of January, and the land could then be turned over in readiness for an autumn crop.

LUCERNE.

Towards the end of September is generally a good time to clean up lucerne stands, either by cutting or by rapid grazing, so that a new crop will come away fresh and quickly. Where necessary, and where the land is dry enough, the period mentioned will also be a suitable one for giving the stand a spring cultivation, with the object of loosening the surface soil and letting the air in. If the conditions are unsuitable, however, it is much better to defer the cultivation until the next cut is removed. Generally speaking, a cultivator fitted with lucerne-teeth will be found the most suitable machine to use, but there are times when it is advisable to use the disk to cut the grass-sods into small pieces, and follow this with the cultivator or weighted tine harrows. When using the disk harrow the disks should be run nearly straight.

Stands that have not been top-dressed during the last year or two and are showing any signs of reduced yields may with advantage be top-dressed with 2 cwt. or 3 cwt. of super or basic super per acre. This will be especially beneficial if the land has been well limed during the winter.

Preparation of land intended for the establishment of lucerne should now be attended to. Where a cover-crop is available for green manure it should be turned under at once, so as to allow it plenty of time to become well rotted before the lucerne-seed is sown. If it is not possible to get the crop turned under by the end of September the better plan is to feed it off with stock and turn under the droppings. If the roots of recently germinated lucerne come in contact with half-decayed material they get burnt off, fail to penetrate the mass, and in consequence the stand is greatly checked and frequently ruined. Lea land and land that has just grown a crop should be ploughed deeply so as to smother as many weeds as possible, and the top 3 in. worked from time to time to germinate and destroy seedlings. Lime should be applied as soon after ploughing as possible, at the rate of 10 cwt. to 20 cwt. per acre.

GRASS PASTURES FOR HAY OR ENSILAGE.

Pastures intended for hay or ensilage should be well cleaned up during the coming month, so as to remove all old grass and give a clean bottom, with a view to shutting up about 1st October. Before being actually closed the pastures should be well harrowed with tripod and chain harrows, and if the land has not been recently top-dressed from 2 cwt. to 3 cwt. per acre of super or basic super may be applied with great advantage.

Particulars of special crops for hay and ensilage were given in last month's notes.

RENOVATION OF RATSTAIL GRASSLAND.

Large areas of coastal land and much of the soft hydraulic limestone country of Auckland Province originally sown in English grasses have, through neglect and bad management, reverted to an almost pure ratstail association. Much of this country is now being used for dairying, and for this purpose ratstail is entirely unsuited; it must be replaced by more succulent and palatable grasses and clovers. Old

ratstail, with its mass of deep and fibrous roots, is extremely hard to plough, and altogether the breaking-up and resowing of a paddock is a very costly affair. Moreover, even when a fresh sward of grass is established the same process of reversion will take place unless the fertility is maintained by means of top-dressing.

There is a cheap and efficient method of rapidly converting dry, harsh ratstail into a good dairy pasture. Its success depends on the fact that ratstail has taken charge, not because it is an aggressive species and has thus ousted the rye-grass and cocksfoot, but because the soil-fertility has fallen so that these species cannot thrive, and therefore are replaced by ratstail, which soon smothers out the clovers by shading them. The method is to remove the shade, increase the fertility, and introduce the new grasses and clovers under these conditions. Rye-grass, cocksfoot, and clovers will then compete successfully with ratstail, which, moreover, after top-dressing, becomes more palatable, and is eaten down accordingly.

The paddock should be closed from the late autumn on, so as to allow of plenty of growth for a clean burn. The ratstail is fired in September while the ground is still moist. This prevents the fire from burning too close to the ground and so destroying the few remaining stunted rye-grass and cocksfoot plants which have managed to survive. The ash from the fire forms a good seed-bed, and on it is sown a mixture of rye-grass, cocksfoot, crested dogstail, and red and white clover, with 3 cwt. to 4 cwt. per acre of superphosphate. An average mixture suitable for the purpose would be: Italian rye-grass, 4 lb.; perennial rye-grass, 6 lb.; cocksfoot, 5 lb.; red clover, 4 lb.; white clover, 1 lb.; crested dogstail, 2 lb.: total, 22 lb. per acre.

It will often be found that the top-dressing brings away many old and stunted rye-grass and cocksfoot plants which have been for years covered by the ratstail, and for this reason in cases where the pasture was originally sown in English grasses, and the area has not been burnt over to any extent, only clovers need be sown. The grass and clover seed can be mixed with the superphosphate, but must be sown soon after mixing. Many excellent pastures are to be found which have been built up by annual top-dressings with phosphates following the above-described initial process of replacing the ratstail by surface-sown grass.

The winter feeding of ripened hay from a good top-dressed pasture, together with roots such as mangolds or swedes on ratstail pastures such as described, is another sure and cheap method of raising the fertility, introducing fresh grass-seed, and so creating conditions such that the English grasses can once more compete successfully with the ratstail. Both these methods have been used with complete success.

—*Fields Division.*

LAMBING-PENS.

In many cases, more especially with flocks of up to, say, 2,000 ewes, it is very convenient to have a small yard with a few lambing or mothering pens. The yard should be fenced off in the corner of the lambing-paddock, with strong stakes driven well into the ground and just the length of a hurdle apart. Wire the hurdles to the stakes,

FIG. 1. LAMBING-PENS AT WALLACEVILLE LABORATORY FARM.

Manuka scrub was used in the construction of these. The three pens are here shown closed.

FIG. 2. SHOWING ONE OF THE PENS OPEN, WITH EWE AND LAMB INSIDE.

[*Photos by H. Drake.*

leaving a gateway close to the main fence. Then make up bundles of straw or brush and stand them on end on the other side of the fences, particularly on the side that the prevailing wind comes from during the lambing-period. Tie the bundles there with light wire, flax, or binder-twine, also round the part where the hurdles are fixed. Now fix up the pens, which will require to be large enough to allow the ewe

to move about comfortably. Fasten one end of the hurdle to the fence where the straw is placed, and drive in a stake to fasten the other end to. Having fixed up the number required, put another hurdle across the front, making one end secure and leaving the other loose until the pen is required for use. Then place a few rails or battens along the tops of the pens, and place the straw or brush on these. This forms a roof and helps to keep the ewe quiet when put in, besides giving her and the lamb protection from rough weather. This sort of lambing-yard will be found especially useful for merino ewes that have been mated with longwool rams.

—J. G. Cook, Live-stock Division.

THE ORCHARD.

SPRAYING OPERATIONS.

JUST when to commence spraying and what mixtures and strengths to use will be the dominant thought in growers' minds during the early weeks of September. The results obtained during the previous season should form a guide as to future procedure. The growers who succeeded in getting a crop of apples free from black-spot (or practically so) will, if they be sensible, repeat the programme of last year, and the careful man will have his data at hand.

That one grower will get good results from the same mixture and strength while his neighbour gets the reverse is often true, but the mixture cannot be to blame, and we must look to some other factor for the cause. Was it the time of application? Was it lack of care? Or did the wet spell, unfortunately, come at the wrong time? The weather factor is not in our hands, but we can make the best of our opportunities by seeing that the pump is in good working-order and hoses tight. If the spray is on and a downpour comes, one should not wait until the scheduled interval elapses between sprays, but get to it as soon as possible and adjust the strength of mixture to suit the conditions, getting on two fungicides ahead of the bloom period if the best results are desired.

The strength found most suitable in the locality for the varieties grown should be used, as local conditions vary greatly. If bordeaux is fancied for a start, my advice is 5–4–50 at tight to open cluster, and ten to twelve days later lime-sulphur, 1–50, on the harder kinds. Otherwise lime-sulphur, 1–20 to 1–25, followed by 1–50. If a little russet does not matter, bordeaux, 3–4–50, can be used for the second application; but if red-mite eggs are present on the trees beware of trouble, for mites take a lot of catching after the bloom period. When bordeaux is decided on, the trees should receive an application of red oil of a strength consistent with the stage of development.

The spraying of pear-trees was fully dealt with in last month's notes. In some localities, however, it may be found that one spray of bordeaux, 3–4–50, at open-cluster is quite sufficient for the Winter Cole and Josephine varieties.

A further application to stone-fruit trees of bordeaux, 3–4–40, at colour-bud will help to further check leaf-curl, shot-hole, &c., and help to prevent brown-rot, but if growers wish to secure the best results all mummy fruits must be destroyed.

CULTIVATION.

Many orchards have not yet received the annual ploughing. This should be done before the time arrives for black-spot spores to germinate. Green crops will also be ready to plough under about this time. Some lupin crops are already well in bloom and at their best for turning under. Trees should be dug round also, to bury as many leaves as possible. Where digging has been neglected for a season it is very necessary, as the rubbish also forms cover for brown-beetle, earwigs, leaf-hopper, &c. Cultivation near the tree has more advantages than disadvantages in many respects, and well repays the necessary outlay.

GRAFTING.

The working-over of unsuitable varieties to more popular sorts can be undertaken towards the middle of September and for a couple of weeks later. Where there is a good foundation in the trees, use should be made of several of the limbs, as much quicker returns will thus be secured. About four to six limbs may have scions inserted. A couple of the original branches should be left to allow the trees to function properly, and also control to some extent the liability to silver-blight, but care must be taken that no swaying branches are in close proximity to the scions, otherwise they may be torn out.

—J. H. Thorp, Orchard Instructor, Nelson.

CITRUS-CULTURE.

In the majority of citrus groves little or no autumn growth was made last season, owing mainly to the prolonged dry spell. With the late abundant rains and the advent of warm spring conditions trees will in all probability make more spring growth than usual. In anticipation of this, seasonable work for the month will be as follows:—

Planting: Where replacements are required or new plantations are being made, an effort should be made to complete the work by early September.

Pruning: Complete the work outlined in the July *Journal*, and treat all borer-cavities by an injection of benzine, afterwards blocking the hole with soap or putty.

Cultivation: Towards the end of the month spring cultivation should be carried out. This includes ploughing, to turn in green crops which have been grown for that purpose, or weeds, which are best disposed of at this period by being turned under. Even if the soil is in a clean condition, ploughing at this period is beneficial, as it breaks up the compacted state and permits aeration. In most citrus groves there is an area near the trunk of the trees which cannot be ploughed or cultivated by horse-implements. In order that this area may be dealt with by the hoe later in the season spade-work is necessary at the present time. If this land is not dug over now fibrous roots become so dense later on as to make it inadvisable to more than scratch the surface for fear of injuring the roots. On the other hand, digging the land now, when fibrous roots are least plentiful or necessary, a condition is secured which allows several inches of soil to be kept in good tilth during the summer.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

HATCHING CHICKS AND DUCKLINGS.

THE end of September, or, at any rate, early in October, may generally be regarded as the end of the correct season for hatching out chicks of any breed, because chicks brought out later seldom or never prove satisfactory. Thus no time should be lost in placing the last of the eggs in the incubators or under the natural mother. There are many factors to be considered in successful poultry-keeping, but there is not one factor of greater importance than the avoidance of having late-hatched stock on the plant. In these days of high-cost foodstuffs it is particularly important that the young stock be hatched out during the early season.

There is yet ample time to hatch out ducklings for the renewal of the laying flock, but September should see all eggs undergoing the process of incubation for the production of ducklings for the Christmas market. To cater for this trade the eggs should be put down about fifteen weeks before the young birds are to be marketed. This will allow twenty-eight days for hatching (the natural time), and the remainder for rearing the birds to prime condition. In this connection it is always a wise course—whether it be with table ducklings or poultry stock intended for the Christmas trade—to market them at least a few days before the festive season sets in. In this way those poulterers who cater for the best trade are given an opportunity of preparing the birds for market and placing them in the freezer to await for the rush.

A little point may be mentioned here in regard to mating ducks. They should be mated well in advance before the eggs are required for hatching purposes, or a high percentage of infertile eggs may be expected. Usually ducks, especially the heavy breeds, have to be mated much longer than fowls in order to ensure a maximum number of fertile eggs.

THE NON-LAYERS IN WINTER.

A correspondent who has been looking for eggs for many weeks past from his adult flock, and without any result, is now getting tired of poultry. He asks whether, in view of the present cost of food and declining price of eggs, it would not pay better to cull out the birds rather than continue feeding them for nothing. Although these fowls have been earning nothing during the past few months I would advise this and other correspondents in a similar position not to resort to drastic culling at the present time of year. This work should have been done in the autumn. The natural laying season for bird-life is approaching, however, and it will be a very inferior fowl that will not pay her way, even if foodstuffs are dear, before the next moult comes on. Of course, the better the feeding and general management a bird receives the earlier will she come into profit. Failure to secure eggs in the season of high prices is usually put down to bad luck, but more often than not is the result of bad management, some essential detail having been neglected. It must be realized that late autumn and winter eggs are an artificially produced product. Therefore if they are to be secured in good numbers the pullets which are hatched in other

than the natural season must be chiefly relied upon to produce them. Neither late-hatched pullets nor adult hens can be depended upon in this respect. Practically any old hen will lay during the spring and summer season when eggs are cheap. The secret of winter eggs is to have the full complement of chicks hatched out at the earliest date possible.

MARKING CHICKS AND ADULT BIRDS.

Few poultry-keepers realize the value of marking their chicks in order to distinguish the young from the old when culling is necessary—as it is every season if only profitable birds are to be retained. There is practically no definite means of telling the age of a bird by its general appearance. This being so, the punching of a distinctive mark in the web of the foot will serve as a good means of age-determination. It should be remembered that even in the best of flocks the egg-returns from second-season birds are at least 30 per cent. lower than in the pullet season, while the cost of production is just the same; and the yield more rapidly decreases after the second year. Therefore this necessary detail should not be delayed. It is the only safe means whereby the common mistake may be obviated of sending a young profitable bird to market and retaining an old unprofitable one. A punch made for the purpose can be purchased for about 2s. With this the chicks can be marked when leaving the incubator, and by keeping a register the different strains and ages of the birds can be ascertained at a glance.

For marking adult birds one of the most effective and cheapest rings is that commonly used in a pig's nose to keep it from rooting. These are obtainable in both the round and flat forms. They may be easily put on the leg of a fowl with a pair of closing pinchers as used for ringing a pig, and when once on there is little or no chance of their falling off. For pedigree-breeding purposes the flat rings may be numbered by means of a small set of steel punches numbering from one to zero.

NON-ABSORPTION OF YOLK IN CHICKS.

Failure to absorb the yolk of the egg, which is drawn into the body of the chick just before it leaves the shell, is a common cause of mortality during the brooder stage. It is generally believed that failure of the yolk to digest is due to feeding the chicks too soon after hatching, or to overfeeding during the first week. It is also often considered that breeding from overfat hens is responsible. These factors may have some influence in regard to this condition of the yolk, but experience goes to show that it is due more to improper incubation than to any other cause. This is borne out to a great extent by the fact that the trouble is seldom found in chicks that have been hatched by the natural mother. There it will be found that the yolk in its sac is in a more or less liquid state, which enables it to run freely and finally become absorbed. With incubator-hatched chicks the chief weakness probably lies in having the temperature too high during the whole or a part of the incubating-period, thus causing half-baking of the yolk and rendering it incapable of absorption. If such trouble is to be minimized it is of the first importance that every care should be taken to prevent an excessive degree of temperature in the incubator.

GREEN FEED.

In these days of high-priced foodstuffs poultry-keepers in general will be well advised to give more attention to growing green feed. In districts favourable for the growing of lucerne I would advise the establishment of this plant. Where local conditions are not favourable for the growing of lucerne it is well to provide a substitute. An excellent plant for the purpose—one that can be grown practically anywhere, and which gives a great wealth of feed during the greater part of the year—is silver-beet. Where watercress is available nothing more is required by way of green-stuff. It not only has the effect of maintaining a bird in good health, but gives a good colour to the yolk of the egg. There is, as a matter of fact, a great variety of plants to select from for green-feeding purposes. Rape, cabbage, carrots, and clover may be grown to advantage. Green oats cut when short and finely chaffed are also good. For choice, however, as a laxative food and for the average locality, I would recommend silver-beet.

—F. C. Brown, Chief Poultry Instructor.

THE APIARY.

SPRING WORK.

By this time the first examination of the hives should have taken place. As stated last month, the question of stores is of first importance, and every effort should be made to provide the bees with ample food to carry them on until nectar is available. Owing to the exceptional severity of the winter this year, particularly in the South Island, it may be found in many cases that the bees have not consumed as much honey as usual. The weather conditions will probably also have influenced brood-rearing to a large extent, and, although brood may normally be found in the hives by the end of July, this year abnormal conditions have prevailed, and it will be unwise to judge a colony queenless because there is no brood showing at a first examination. With the advent of warmer weather the colonies will soon build up to their usual strength.

When colonies are weak, or show other signs of a poor queen, it is best to kill the queen and unite the colony with a stronger one. It is useless to try and carry a poor colony on to the summer. By the time new queens are available it will have nearly dwindled out of existence, if it has not been robbed out; and even if it lives until it can be requeened it will hardly build up sufficiently to give a surplus in the coming season. Only strong colonies should be tolerated in an apiary, and it is much the better plan to dispose of all the weak stocks and prepare the hives thus vacated for increase later on. A simple method of uniting is to place the weak colony over the strong one with a single sheet of newspaper between the two hive-bodies. The bees will gnaw the paper through and unite quite peacefully in a day or two.

PRECAUTIONS AGAINST ROBBING.

All work which necessitates opening the hives should be carried out as expeditiously as possible, and no hives left open longer than

can be helped. No combs should be exposed to the bees at this time of the year. It is a good plan to carry an empty super round on a barrow, in which the end combs can be placed and covered while the work of examining the colony is going on. It is necessary to remove one comb at least, so that the rest may be easily handled, but this comb, however dry, is as well kept out of the way of would-be robbers. Spring robbing, once started, may become as disastrous as autumn robbing, and must on no account be encouraged. All feeding should be carried out just before dusk, and if any syrup is spilled it should be at once covered up or removed out of harm's way.

STARTING AN APIARY.

The beginner who is desirous of starting an apiary may commence at any time now. For the next month or two he will only be able to obtain established colonies, as swarming is still several months ahead. If he decides to commence at once, and thus obtain the full benefit of the season's experience, he should get into communication with a reliable breeder and obtain nothing but absolutely guaranteed stocks. On no account must the tyro be led away by the apparent cheapness of bees offered for sale. If he should contemplate purchasing any other than those of any apiarist who makes the sale of bees his business he should have his prospective purchase examined by some person of experience, and be quite certain of the cleanliness of the colonies before taken possession. The sale of diseased bees is forbidden by law; but, apart from that, they are a dear bargain, as they will cost much in money and time to bring them to a healthy condition, and, moreover, will yield nothing during the first season. A good hive purchased now, placed in a sheltered position, and carefully watched to see that its stores are sufficient to last it till nectar is abundant will probably (if the apiarist desires it) yield a good swarm, and both parent hive and swarm should give a surplus when the main honey-flow arrives.

ISAAC HOPKINS.

The death of Mr. Isaac Hopkins, the well-known bee-master, removes a conspicuous figure from the apicultural world. Not only was he familiar to most New Zealand apiarists, but his reputation as an ardent student of the craft extended to almost every country where apiculture is practised.

For the past fifty years Mr. Hopkins had been closely associated with apicultural development in New Zealand. Starting with a gin-case hive in 1874, he at once saw that there were great possibilities for development of the business. Not satisfied with the methods in vogue at the time, he tried in succession types of bar-frame hives such as the Stewarton and others, but as these proved only to be a slight improvement on the gin-case they were soon discarded. In 1879 Mr. Hopkins secured a copy of "Langstroth on the Honey-bee," and from this work obtained specifications of the first movable-frame hives. As these proved to be a distinct success, a number were made and brought into use the same season. In the same year he imported a direct shipment of modern bee-supplies from Root's, including a comb-foundation mill. The establishment of his apiary at Parawai, Thames, replete with the latest appliances of the day, was the subject of much

attention, and attracted many notable persons, including the late Sir George Grey, who was greatly interested in modern apicultural methods. Early in 1880 he contributed notes on practical apiculture to the *Thames Advocate* and the *Auckland Weekly Press*, and subsequently published the first edition of his "Bee Manual." This book was well received, and in thirteen months a second edition was published When publishing the third edition he altered the title to "The Australasian Bee Manual," finding that it had a wide circulation in Australia. The sixth edition is now in the printer's hands, and will be available shortly.

In conjunction with the late Mr. J. C. Firth, Mr. Hopkins established an apiary on commercial lines at Matamata. At this apiary he developed the breeding of Italian queens, and sent them to all parts of New Zealand, Australia, and several of the South Sea islands. At this time he successfully imported Holy Land bees and other races, but after an extended trial preferred the Italian race with which he had been so successful. Owing to ill health Mr. Hopkins removed to Auckland City in 1887, and then commenced to organize and take active interest in the New Zealand Beekeepers' Association. This organization under his guidance promoted the Foul-brood and Disease in Bees Prevention Act, which was introduced during the parliamentary session of 1888. Although the Bill was shelved, it created much interest in apiculture at the time.

In January, 1905, Mr. Hopkins was appointed Government Apiarist, and at once commenced to draft the first Apiaries Act, which eventually became law in 1907, and was consolidated in 1908. While Government Apiarist he forwarded samples of comb to Dr. E. F. Phillips, Washington, U.S.A., for examination. The comb proved to be infected with foul-brood (*Bacillus larvae*). This was the first indication that the disease was present in New Zealand. Mr. Hopkins was instrumental in starting the Ruakura State Farm Apiary, and also compiled the first edition of the departmental bulletin on "Bee-culture."

Rightly has Isaac Hopkins been named the "Father of Beekeeping in New Zealand." His long association with apiculture, his readiness to help beekeepers with the difficult problems of the craft, and, above all, his unswerving loyalty to New Zealand beekeeping interests will place his name in the honoured ranks of the pioneers who worked for the advancement of our primary industries.

—E. A. Earp, Senior Apiary Instructor.

HORTICULTURE.

VEGETABLE-GROWING.

ANY fine, dry weather experienced in the spring of the year should be devoted almost entirely to the hoeing of growing crops and the preparation of the land for further cropping. The opportunities are sufficiently rare, and if they are not taken crops become overgrown and the weather is blamed; great losses are due to neglect in this respect. Cabbage, cauliflower, lettuce, artichokes, early potatoes, shallots, garlic, and onion plants put out during the months of July

and August will require this attention, also early peas, lettuce, and onion crops sown about that time.

During September the main root crops — parsnips, carrots, beet, main-crop peas, celery, leeks, parsley, and salads — should be sown.

Where the convenience of a hotbed is available, sowings of tomatoes, egg-plants, Chile peppers, cucumbers, and melons should be made at this period. The facilities are at hand on most farms. It is necessary only to realize the principles underlying the operation of making a hotbed. A quantity of *fresh* stable manure is required, sufficient to make a stack about 3 ft. high and 1 ft. wider and longer than the frame to be used. Place the manure in a compact heap, and in three or four days it will generate a considerable heat by fermentation. Then turn it over, shaking it out and moistening with water any portion that is dry. After a similar interval repeat the process, and again possibly a third time, the object being to have the whole mass in a state of steady fermentation. When ready, build the hotbed about the dimensions mentioned, and place the frame in position. In a few days it will be sufficiently hot, when it should be thoroughly watered, and it is then ready for use. It should be built in a sheltered, well-drained locality.

Preparation of the land for new plantations of rhubarb and asparagus should now be completed and the plants put out. Do not be tempted to plant before the land is ready; it is better to defer the operation for a year. Pulling of the variety known as winter rhubarb should now be stopped, and the plants given a liberal dressing of manure. Established beds of asparagus should now receive liberal dressings of manure. When doing this remember the special preference of asparagus for nitrate of soda.

The main potato crop is due for planting in the coming month. Every care should be taken to secure seed that is clean, true to name, unmixed, and of good strain. Remove the new shoots from sprouting kumaras as soon as they are of sufficient size, and heel them in closely in a well-sheltered position until the time comes for planting them out. Cover them with mats on nights when frost threatens.

Where tomatoes are to be grown under glass the plants should now be placed in their permanent positions if this has not been already done. If the house has been neglected during the winter and the soil has become very dry it should receive a good soaking with water before the plants are put out; otherwise it is usually best to keep the house rather on the dry side at this season. Land outside to be planted in tomatoes should now be carefully ploughed, turning the cover-crop growing on it well in. A dressing of lime before harrowing will usually be an advantage.

SMALL FRUITS.

Plantings of Cape gooseberries that are to be grown for a second season should be cleaned up towards the end of the coming month, the land ploughed, and a dressing of manure applied and harrowed in.

Plants of the edible passion-vine should now be planted out in their permanent quarters. Although they grow readily in quite indifferent localities, they will not continue to crop heavily without generous treatment.

Thoroughly clean strawberry-beds as the weather permits, and give them a good dressing of soluble fertilizers, harrowing the material in. Suppress all runners from plants expected to bear a crop of fruit.

TOBACCO.

Further tobacco seed-beds should be sown in the coming month; it is desirable to have extra beds in reserve in case of accidents or unusual weather conditions. Continue with the preparation of the land in which the seedlings are to be finally planted out. During the ensuing month, as the natural temperature then rises, is the correct time for fermenting stocks of cured tobacco-leaf. In order that due preparation might be made, details of this operation were given in the June number of the *Journal*.

TRANSPLANTING, PRUNING, AND TRIMMING.

September closes the season during which shrubs and trees may safely be transplanted. The sooner such work is now completed the better the results are likely to be. Any pruning or trimming of such plants that may be required should also be completed now. Too often does one see shelter-trees, hedges, &c., cut hard back during summer and seriously injured thereby. The most that can be done safely during the growing-period is to trim back the current season's growth. Most plants used for hedges will stand that treatment.

LAWNS AND GRASSES.

The feeding and top-dressing given to lawns during autumn and winter will now begin to show result in a strong growth of good colour of the finer grasses. To have the greens in high condition for summer games constant attention will be required in the way of cutting and rolling.

—*W. C. Hyde, Horticulturist.*

CASE OF PIGS SUCKING HEIFER.

Mr. J. L. Morris, Inspector of Stock at Cambridge, sends the photo here reproduced, together with the following note: "Owing to my taking my annual leave I was obliged to put the heifer shown in the snapshot out on a neighbour's farm, as she was close to calving. She calved about the middle of January last. She had an abnormally large udder for a two-year-old beast, and just before she calved the milk was probably causing her pain. This, I think, caused her to take to the pigs. Directly the pigs were let out from the stye the heifer used to call to them, and it was very amusing to see them trotting up to her and sucking as gently as could be. I have seen as many as seven of them taking their turns at sucking—and great strong store pigs at that. It will be understood that the pigs were not allowed to run to her freely after the matter was first observed—only at times to give demonstrations to the sceptics and others. She was intended for a house cow, but we did not fancy her for that purpose after she took to the pigs."

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

RAGWORT TROUBLE WITH CATTLE.

"WEST-COASTER," Brunner :—

The rough unploughable parts of my paddocks are so badly infested with ragwort that the cows are forced to eat quantities of it along with the grass. In this case would the ill effects of eating it be counteracted by feeding some other foods; if so, what would you recommend, and would linseed-meal be beneficial? What remedies could be applied to a cow affected by eating ragwort?

The Live-stock Division :—

The effect on cattle from eating freely of ragwort is a condition known as "Winton disease." This results in cirrhosis of the liver, and is fatal in cattle and horses—no known treatment being of any avail. The condition has been produced by feeding quantities of ragwort experimentally, the disease in this way developing in about one month. Under natural conditions, when cattle are feeding in ragwort-infested paddocks the average period taken for the disease to develop is about three months. As your paddocks are so badly infested, removal of the cattle from them (if feasible) is the most advisable course to pursue. In other districts where the disease has appeared sheep have been used to graze off the ragwort. Although they are not entirely immune to its effects, sheep can eat a considerable quantity without showing any apparent symptoms of the trouble. In this way much of the plant in ragwort-infested areas may be got rid of. We cannot recommend any other foods to counteract the trouble. No medicinal remedy has so far proved efficacious.

TOP-DRESSING DRY GRASSLAND.

H. B. E., Hastings :—

Would you kindly advise me as to the best manure for top-dressing grassland? The land is situated at Longlands, on the banks of the old Ngaruroro River bed, and is a dry sandy loam that never gets waterlogged. One of my neighbours dressed part of his land with burnt lime, about 3 cwt. to the acre, but does not seem to know if it has been of much benefit.

The Fields Division :—

The soil conditions described are of such a nature that you are not likely to get results from liming. The whole of the Ngaruroro River bed is of a light stony formation, and the best results are obtained by using a soluble phosphate fertilizer. We advise top-dressing with 44–46 superphosphate at the rate of 2 cwt. per acre, applied in August.

SPRAYING FRUIT-TREES AGAINST BROWN-BEETLE.

"SUBSCRIBER," Te Puke :—

Will you please advise me the best spray for preventing brown-beetle from attacking fruit-trees? Year after year they swarm on to my trees in the evening and devour leaves, bloom, and shoots from peaches, plums, and apples. Is the small white-headed grub one digs up the beetle in another stage?

The Horticulture Division :—

The best method known at present for combating the attacks of brown-beetle on the foliage of fruit-trees in spring is a combined spray of arsenate of lead with a casein ingredient to thicken and help spread it. The larvæ of the beetle are the white grubs often found in light lands in considerable quantities, and well known as the "grass-grub."

PASPALUM FOR TAKAKA DISTRICT.

C. C., Takaka :—

I have an area of somewhat poor low-lying land growing manuka, light rushes, and fiorin, which I am draining and clearing. Might I expect any success in sowing paspalum after a burn ? Also, I am ploughing some of this land and it is (at present, at any rate) too damp to think of cultivating frequently. Would you give some idea if it would be wise to sow this ploughed land in paspalum ?

The Fields Division :—

Paspalum has been successfully established on certain areas in the Takaka district and should grow on your land, but is not likely to establish quickly or certainly from surface-sowing after a burn. You are advised to sow paspalum only after ploughing and as much cultivation as is possible under the adverse conditions mentioned. A mixture somewhat as follows is recommended : Cocksfoot, 10 lb. ; perennial rye-grass, 15 lb. ; white clover, 2 lb. ; subterranean clover, 1½ lb. ; Paspalum dilitatum, 8 lb. : total, 36½ lb. per acre. By ploughing the land prior to sowing the grass-seed, the latter is given a good chance to make its appearance before fiorin is able once again to come into possession. Of course, the sowing would be best made in March, but it may now be as well to sow towards the end of August. This practice, admittedly unsound in many other districts, would probably, under the climatic conditions of your locality, be fairly safe.

SCALE ON ACMENA FLORABUNDA TREE.

G. W. M., Whangarei :—

Please find enclosed a branch of *Acmena florabunda* attacked with scale. The scale is just commencing to appear on the lower branches of the tree. Kindly inform me how to destroy it without injuring the foliage.

The Horticulture Division :—

For controlling the scale on the Acmena you are recommended to apply red oil, ½ pint, diluted with 3 gallons water in early summer, when the plant has started into growth, repeating the application after about two or three weeks. Emulsify the oil in an equal quantity of water before diluting further.

NITRATE OF SODA AND PASTURE TOP-DRESSING.

F. S. Ruthe, Leigh, North Auckland :—

Could you tell me if nitrate of soda is a suitable manure for top-dressing grass and clover on a light volcanic soil ? Also, will it mix with lime, and, if so, what is the best form and quantity of lime to mix it with ?

The Fields Division :—

Nitrate of soda as a top-dressing will give an increased bulk of pasture, but at the expense of the available phosphates and potash in the soil. The nitrogen-supply is best maintained on a pasture and soil such as you mention by the use of phosphates and lime, which promote the growth of clovers and also create the most suitable condition for soil bacteria, both of which are able to make available for plants nitrogen in the form of nitrates. Again, the frequent use of the chain harrows, by spreading animal-manure containing large supplies of nitrogen, reduces the necessity for using high-priced artificial nitrogenous manures. Chain-harrowing also allows the air necessary to bacterial life to enter the soil. These bacteria also require lime and phosphate. Some are able to take nitrogen from the air and make it available to plants, and others make the nitrogen on dead vegetation and animal-droppings available while others living on the roots of clovers get nitrogen from the air and pass it on to the pasture plants. An application of 4 cwt. to 5 cwt. of lime every three to four years, and an annual top-dressing of 2½ to 3 cwt. per acre of superphosphate or basic super will give best results. Kainit, at the rate of 1 to 2 cwt. per acre, or ½ cwt. of sulphate of potash, may be used profitably on such soils every few years.

HORSE WITH LAMPAS.

C. CAMPBELL, Takaka :—

I have a six-year-old horse troubled with lampas, and he is looking miserable and unthrifty. Kindly advise me what is best to do with him.

The Live-stock Division :—

The condition of lampas is quite natural, but may be accentuated when there is some irritating condition, as in stomatitis or teething, and is sometimes met with when an animal is suffering from stomach or bowel trouble. Soft feed should be given, and cold water be available. A dose of physic might be advisable.

DAIRY PASTURE FOR ASHBURTON LIGHT LANDS.

"DAIRYMAN," Westerfield :—

I should be obliged if you would inform me in what proportions to sow perennial rye-grass, red clover, cocksfoot, and Danthonia pilosa on the light land of Ashburton County. I propose to use the feed for wintering dairy cows. If you do not consider this mixture suitable, what would you suggest ?

The Fields Division :—

On the light lands of Ashburton County perennial rye-grass and red clover form pastures of very short duration. If permanence is a consideration it would be wise, therefore, to have cocksfoot, crested dogstail, white clover, and perhaps danthonia as the dominant constituents. The following mixture would be suitable : Perennial rye-grass, 8 lb. ; cocksfoot, 10 lb. ; crested dogstail, 2 lb. ; white clover, 2 lb. ; Danthonia pilosa, 4 lb. : total, 26 lb. Red clover is omitted for the reason that should it do well during the first year its effect, through providing too much shade, would be detrimental to the establishment of the bottom grasses such as crested dogstail, white clover, and danthonia.

PASTURE-ESTABLISHMENT ON COUCH-INFESTED PUMICE LAND.

C. B. R., Mount Maunganui :—

Would you kindly advise me of the best method of dealing with worn-out pasture badly infested with couch ? It is pumice land, which I am anxious to get into good permanent pasture.

The Fields Division :—

As your land is light in texture, any procedure to eradicate couch or twitch must include replacement of organic matter to build up the soil-fertility necessary for the successful strike and maintenance of a good permanent sward. You should graze the land as bare as possible, which will help to consolidate the area for the subsequent operations. Skim-plough immediately, setting the plough to turn as light a furrow as possible. This will expose many of the roots and runners of the twitch, and allow the sun and elements to wither them. As soon as the grass-turf appears to be dead under the furrow, skim-plough again, this time across the first furrow. The land may now stand for a fortnight at least, and then be deep-ploughed. Subsequent operations will consist of preparing a seed-bed for some heavy soiling and smothering crop, such as mustard or blue lupin. It would be advisable to give a dressing of about 1 ton of ground limestone on the furrow and harrow it in. The crop should be sown about October, and turned in as green manure in January. The land should then be well rolled and prepared for sowing down in March with a temporary pasture mixture—say, 25 lb. to 30 lb. Italian rye-grass and 5 lb. red clover. During the hot month of February any twitch that may appear should be harrowed to the surface and exposed to the sun. A liberal dressing of manure should be given at the same time as the seed—say, 2 cwt. to 3 cwt. per acre of superphosphate. Subsequent treatment of the pasture must aim at keeping up the fertility of the soil, so that the better English grasses will be quickly established when the permanent mixture is sown in autumn two years hence. Such treatment consists of systematic liming and manuring, the liberal use of the tripod and chain harrows, and recourse to the mower when the grass runs to seed.

WEATHER RECORDS: JULY, 1925.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE stormy and unsettled conditions which were experienced at the close of June continued for the first ten days of July, particularly in the northern and east-coast districts, where some heavy rains and serious floods occurred. The Waikato River again burst its banks; and the snow which had fallen on the high country, melted by the rains, caused the rivers to be in high flood in South Canterbury.

There was an improvement in weather conditions for a few days after the 10th, but on the 13th dull and misty conditions were again experienced, and some heavy rains were reported during the next three days. Anticyclonic conditions (fine weather) followed until the 21st, when an extensive westerly area of low pressure brought rain and stormy weather again over the Dominion. This rain, however, was particularly acceptable in Otago, where fine and dry weather had been experienced for some time, in contrast to the northern and east-coast districts, which have suffered this winter from an unusual prevalence of cyclonic disturbances.

The barometer rose rapidly between the 24th and 28th, and continued normal, but unsteady, for the last three days of the month.

There were remarkable differences in the totals of the rainfall, even in close neighbourhoods, which makes generalization difficult. Timaru and Oamaru had the highest percentage above the mean for this month, both being over 100 per cent. above the July average. The Bay of Plenty and Taranaki districts were also above the average; but Auckland and Wellington districts, as well as parts of Otago, were below the mean of previous years.

There were several frosts in many parts of the country, but on the whole the weather was mild and humid.

—*D. C. Bates, Director.*

RAINFALL FOR JULY, 1925, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
North Island.				
	Inches.		Inches.	Inches.
Kaitaia	3·78	14	0·58	5·96
Russell	5·95	18	1·64	4·26
Whangarei	4·46	19	0·75	8·33
Auckland	4·17	20	1·15	5·05
Hamilton	6·44	20	1·36	5·24
Kawhia	6·23	20	1·62	6·86
New Plymouth	7·53	19	1·24	6·35
Riversdale, Inglewood	11·49	17	2·33	9·93
Whangamomona	6·87	13	1·88	7·68
Tairua, Thames	8·72	12	2·82	5·15
Tauranga	5·40	16	1·60	4·94
Maraehako Station, Opotiki ..	6·56	11	2·46	4·45
Gisborne	5·20	16	1·05	5·21
Taupo	4·76	11	1·62	4·21
Napier	5·15	16	1·00	3·82
Maraekakaho Station, Hastings ..	5·11	19	1·19	3·65
Taihape	2·43	18	0·58	3·33
Masterton	4·19	20	0·75	4·43
Patea	4·55	17	0·79	4·10
Wanganui	2·46	11	0·69	3·63
Foxton	2·56	5	0·80	3·26
Wellington	4·37	19	1·40	5·61

RAINFALL FOR JULY, 1925—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
South Island.				
	Inches.		Inches.	Inches.
Westport	6·34	22	1·55	6·99
Greymouth	9·85	19	2·83	8·43
Hokitika	13·80	19	3·52	9·10
Arthur's Pass	11·22	15	1·55	12·53
Okuru, Westland	23·62	17	2·58	12·03
Collingwood	11·54	23	2·87	9·65
Nelson	4·94	17	1·18	3·47
Spring Creek, Blenheim	3·40	13	0·90	3·93
Tophouse	3·72	15	1·10	5·65
Hanmer Springs	5·95	9	1·94	5·15
Highfield, Waiau	4·47	10	1·56	3·63
Gore Bay	3·58	13	1·15	3·31
Christchurch	2·98	15	1·31	2·77
Timaru	4·22	11	1·12	1·95
Fairlie	6·65	10	1·80	2·72
Benmore Station, Omarama ..	1·18	13	0·24	1·74
Oamaru	3·71	11	1·11	1·78
Queenstown	1·65	5	1·11	2·01
Clyde	1·08	8	0·44	0·94
Dunedin	5·99	15	1·50	2·99
Gore	1·55	13	0·40	2·05
Invercargill	1·32	8	0·38	3·41

GRADINGS OF BUTTER AND CHEESE, 1924-25.

THE Dominion quantities of butter and cheese graded for export by the Dairy Division during the year ended 31st July, 1925, were as follows:—

Butter: Salted, 65,634 tons; unsalted, 4,582 tons: total, 70,216 tons—an increase of 13·6 per cent. compared with the figures for the preceding twelve months.

Cheese: White, 45,990 tons; coloured, 24,003 tons: total, 69,993 tons—a decrease of 5·2 per cent.

In terms of butterfat, the 1924–25 amounts for butter and cheese combined represent a net increase of 6·8 per cent. compared with those for the preceding year. An advanced high-level record has thus been established for the Dominion.

IMPORTATION OF FERTILIZERS: JUNE QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 30th June, 1925:—*Sulphate of Ammonia:* From United Kingdom, 50 tons; Australia, 278 tons. *Nitrate of Soda:* Australia, 30 tons; Chile, 433 tons. *Basic Slag:* United Kingdom, 8,399 tons; Belgium, 17,969 tons. *Bonedust:* Australia, 305 tons; India, 625 tons. *Chardust:* Australia, 206 tons. *Phosphates:* Nauru Island, 26,442 tons; New Caledonia, 1,978 tons; Egypt, 3,000 tons. *Superphosphate:* Netherlands, 500 tons. *Kainit:* United Kingdom, 294 tons; France, 478 tons; Germany, 280 tons; Belgium, 85 tons. *Muriate of Potash:* France, 10 tons. *Sulphate of Potash:* United Kingdom, 50 tons; France, 145 tons; Germany, 252 tons; Belgium, 20 tons. *Potash, other:* United Kingdom, 135 tons; France, 670 tons; Germany, 339 tons; Belgium, 33 tons.

Correction.—At the head of the first article in this issue the degree of the writer, Mr. Hopkirk, should have been printed as B.V.Sc., not B.Sc.

LIST OF QUALIFIED VETERINARY SURGEONS.

THE following list of qualified veterinary surgeons known to be residing in New Zealand at the present date is published for the guidance of stockowners and for general information. In the event of the name of any properly qualified veterinarian being omitted it is requested that he communicate with the Director of the Live-stock Division, Department of Agriculture, Wellington, giving particulars of his qualification, in order that the necessary steps may be taken for the inclusion of his name in the next published list.

Aberdeen, C., L.V.Sc. (Melb.), Wanganui.
*Ashe, G. G., M.R.C.V.S., Belfast.
Barnes, A. W., M.R.C.V.S., Hastings.
*Barry, W. C., M.R.C.V.S., Auckland.
Bayley, A., M.R.C.V.S., Hawera.
Begg, W. P., M.R.C.V.S., Dargaville.
*Blair, W. D., M.R.C.V.S., Dunedin.
*Blake, T. A., M.R.C.V.S., Masterton.
Brodie, A. M., M.R.C.V.S., Hastings.
*Broom, G., M.R.C.V.S., Gisborne.
Burton, S., M.R.C.V.S., Hamilton.
Carbury, H. W., M.R.C.V.S., Te Aroha.
Cockroft, J. E., M.R.C.V.S., Feilding.
*Collins, W. T., M.R.C.V.S., Wellington.
Crossley, F., M.R.C.V.S., Palmerston North.
Cunningham, T., M.R.C.V.S., Oamaru.
*Danskin, J., M.R.C.V.S., Invercargill.
Davis, W. R., M.R.C.V.S., Wellington.
*Dayus, C. V., M.R.C.V.S., Auckland.
*Elphick, E. E., M.R.C.V.S., D.V.H., Hastings.
Fletcher, S., B.V.Sc. (Melb.), Whakatane.
*Gill, D. A., M.R.C.V.S., Palmerston North.
Glover, F., M.R.C.V.S., Hamilton.
Gregory, J. S., B.V.Sc. (Melb.), Leeston.
Hankin, T. H., M.R.C.V.S., Pukekohe.
*Haugh, P., M.R.C.V.S., Wanganui.
*Hickman, A. J., M.R.C.V.S., Auckland.
*Hopkirk, C. S. M., B.V.Sc. (Melb.), Wallaceville.
Howard, E. C., M.R.C.V.S., Wanganui.
Johnson, A. A., F.R.C.V.S., Christchurch.
*Kerrigan, J., M.R.C.V.S., Christchurch.
Kyle, H. S. S., G.M.V.C. (Melb.), Templeton.
*Lawson, J. N., B.V.Sc. (Sydney), Dunedin.
*Le Souef, H. D., B.V.Sc. (Melb.), Wellington.
*Lukey, E. J., B.V.Sc. (Melb.), Christchurch.
*Lyons, J., M.R.C.V.S., Wellington.
*Mackenzie, A., D.V.S.M., M.R.C.V.S., Hamilton.
*Marsack, H. L., V.S. (Ontario), Auckland.
Marshall, D., M.R.C.V.S., Balclutha.
Martin, H. E., M.R.C.V.S., Christchurch.
*McGregor, P., M.R.C.V.S., Christchurch.
*McIlwaine, J. E., M.R.C.V.S., Wellington.
*Meade, R. H., M.R.C.V.S., Palmerston North.
Miller, J., M.R.C.V.S., Invercargill.
*Paterson, A. M., M.R.C.V.S., Timaru.
Quinnell, W. C., M.R.C.V.S., Wellington.
*Reakes, C. J., M.R.C.V.S., D.V.Sc., Wellington.
Ring, W. C., V.M.D. (Penn., U.S.A.), Ellerslie.
Siddall, E. L., M.R.C.V.S., Opotiki.
Simpson, C. S., M.R.C.V.S., Auckland.
*Snowball, W. D., M.R.C.V.S., Dunedin.
Stafford, J., M.R.C.V.S., Christchurch.
†Stapley, W., M.D., D.V.Sc., M.R.C.V.S., Cambridge.
Taylor, A., F.R.C.V.S., Christchurch.
Taylor, H. C., M.R.C.V.S., Dannevirke.
Taylor, J. B., M.R.C.V.S., Waverley.
Taylor, W. G., M.R.C.V.S., Tokomaru Bay.
*Thompson, A. L., M.R.C.V.S., Wanganui.
*Webster, W. M., M.R.C.V.S., Ngahauranga.
*Wood, R. B., M.R.C.V.S., Waitara.
Young, A. R., M.R.C.V.S., Bell Block.

* Officers of the Department of Agriculture.

† Not practising as a veterinary surgeon.

ARRAN VICTORY POTATO.

IN 1921 the Agriculture Department obtained from England a small quantity of Arran Victory potatoes, a variety then lately introduced. It was claimed to possess good cropping and blight-resistance characteristics, and to be immune from wart-disease. Since then the variety has been well tested in co-operation with several leading potato-growers in the Auckland District, notably Mr. E. J. Bilkey, of Pukekohe Hill, and his brother at Taupiri. At the latter place it was grown on light, good-quality loam typical of the better parts of the Waikato. Mr. T. H. Patterson, Instructor in Agriculture, Auckland, reports that in these trials Arran Victory has proved a consistently good cropper, and that it resists blight. The flavour and texture are excellent for the table. It is considered doubtful, however, whether the variety would become popular on the local market, which favours a white-skinned potato. Arran Victory has a red skin, with a bluish tinge near the eyes.

Live-stock and Crop Statistics.—This year's interim returns show a decrease in total cattle—3,500,832 head as compared with 3,563,497 in last year's final figures. Dairy cows taken separately, however, record a small increase—namely, 1,320,203 from 1,312,589. The area under turnips last season is shown as 452,956 acres, a decrease of 24,425 acres; but the mangold area increased from 9,989 acres to 15,047 acres.